Alvarion BreezeNET B300

Technical User Manual

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Disposal of Electronic and Electrical Waste

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About this Manual

This User Manual is a description of Alvarion devices and contains installation and configuration guidelines, recommendations and troubleshooting sections, and supplementary materials. The document is intended to be used by Qualified RF engineers/technicians and IT professionals. Qualified personnel should have skills and experience in the following areas:

- Outdoor/indoor radio equipment installation
- Outdoor wireless networks
- TCP/IP networking protocols
- Safety procedures and instructions for installing antenna equipment
- Professional manage of electrical equipment and accessories

Safety procedures and instructions for working on towers and heights

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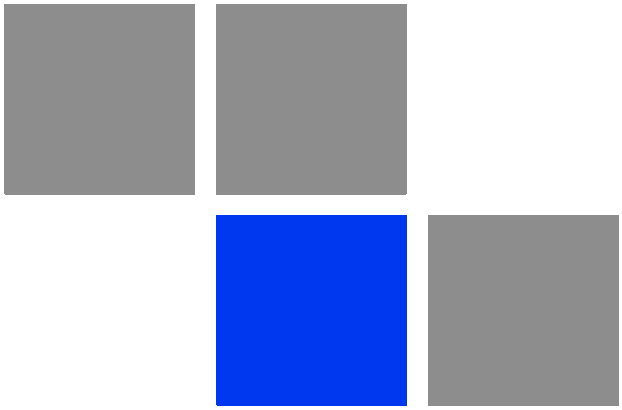
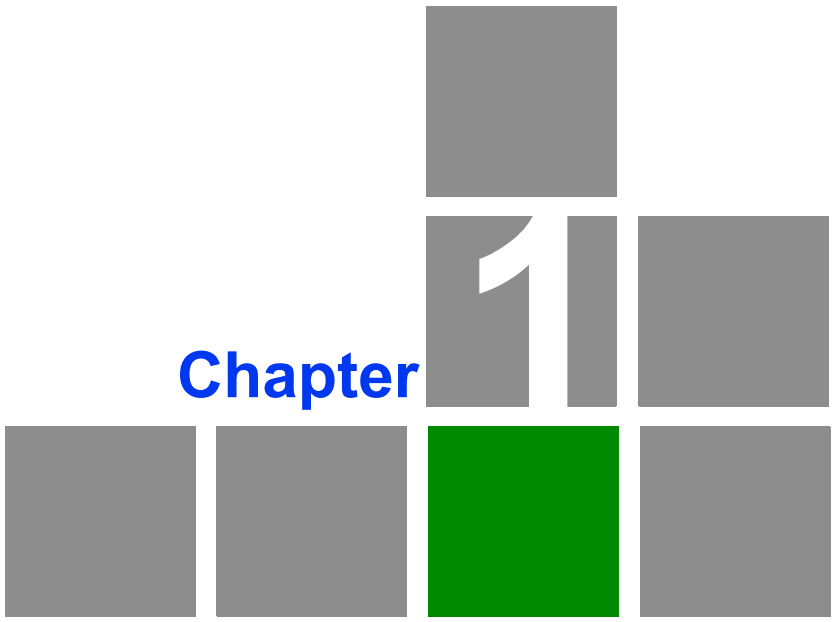




Chapter 1

Getting Started

In This Chapter:

1.1 Scope of Document

This document consists of the following chapters:

- “Getting Started” on page 1 - This chapter includes the information about this document purpose and structure.
- “Hardware Description” on page 6 - This chapter shows the devices appearance and all plugs and connectors.
- “Basic Configuration Instructions” on page 31 - This chapter includes basic recommendations for primary link configuration, including interfaces configuration and MINT protocol usage. Also there is a description of how to perform basic manipulations with device's configuration including its updating, importing and exporting.
- “Link Configuration” on page 45 - The chapter contains basic recommendations for making preliminary choices and decisions while planning and deploying a wireless network based on the Devices. It also describes a set of tools that can help while improving the link quality and statistics gathering.
- “Configuration Via Web Interface” on page 61 - This chapter describes the device's built-in services, features and tools which were not described in previous parts of the document.
- “Supplementary Information” on page 73 - Contains supplementary information (specifications, connectors soldering scheme).

1.2 Abbreviations

The following abbreviations are used in this document:

- ODU - Outdoor Unit
- IDU - Indoor power supply Unit
- RF cable - Radio Frequency cable to connect ODU and external antenna in case connectorized version of the unit is used
- LOS - Line-of-Sight
- STP cable - Shielded Twisted Pair cable (STP Cat5E) to connect ODU and IDU
- PTP - Point-to-Point topology
- MINT - Microwave Interconnection NeTworks

1.3 Document Marks

CAUTION

All caution warnings are marked with a special warning sign. One should pay a great deal of attention to what is written in the Warning sections.

NOTE

All notes are marked with a special note sign. Notes usually contain useful comments or hints to the described section of the document.

Chapter 2

Hardware Description

In This Chapter

2.1 Power supply units (IDU)

2.1.1 IDU-BS

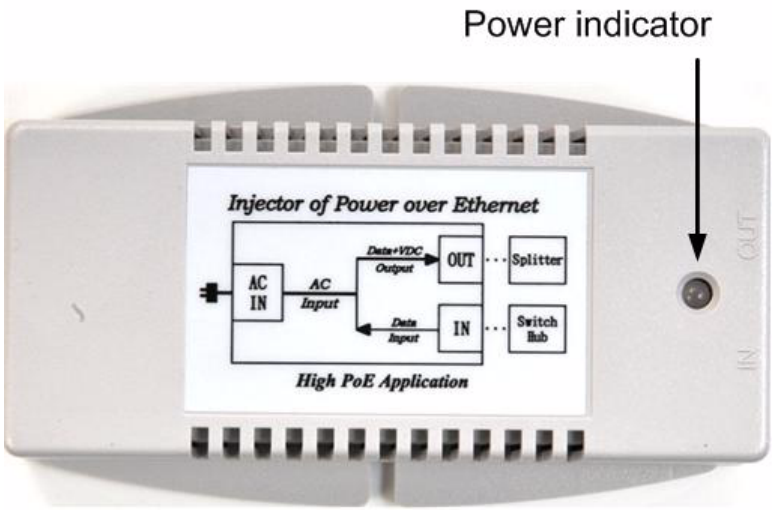


Figure 2-1: IDU-BS Top View

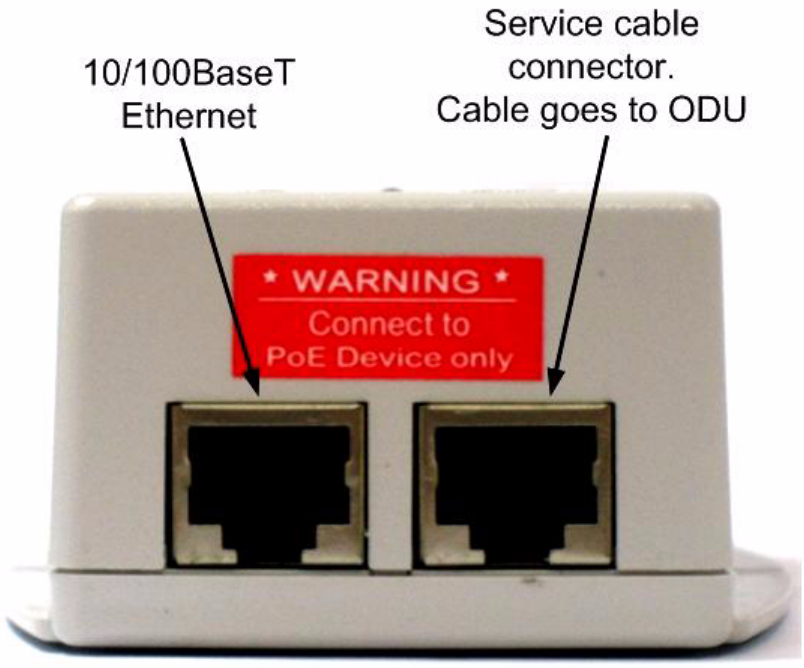


Figure 2-2: IDU-BS Front Panel

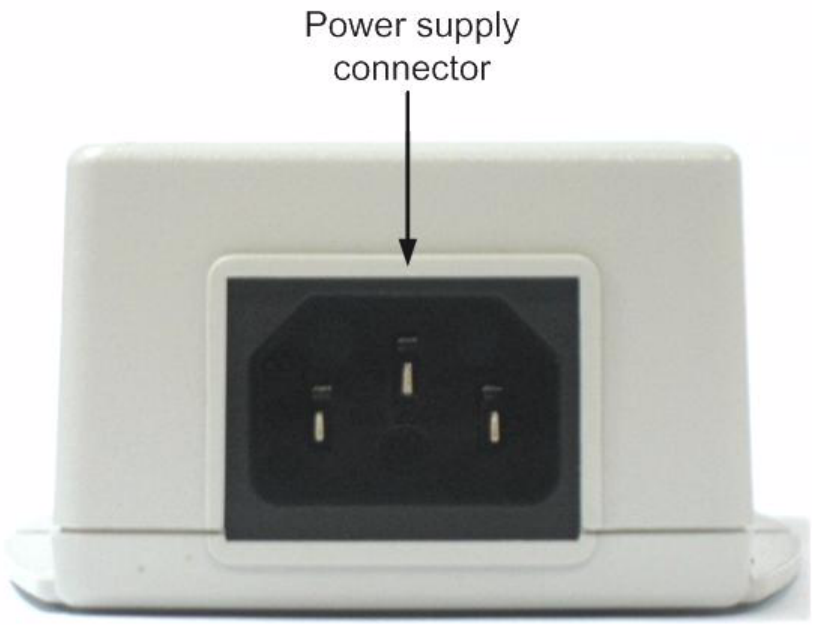


Figure 2-3: IDU-BS Rear Panel

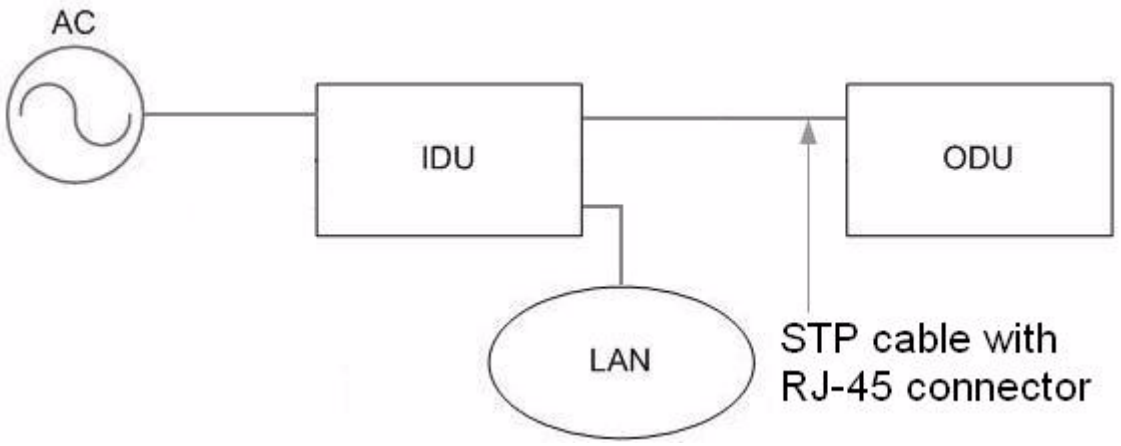


Figure 2-4: Connection scheme for IDU-BS

2.2 Outdoor Units (ODU)

2.2.1 BU/RB-B300D-5X

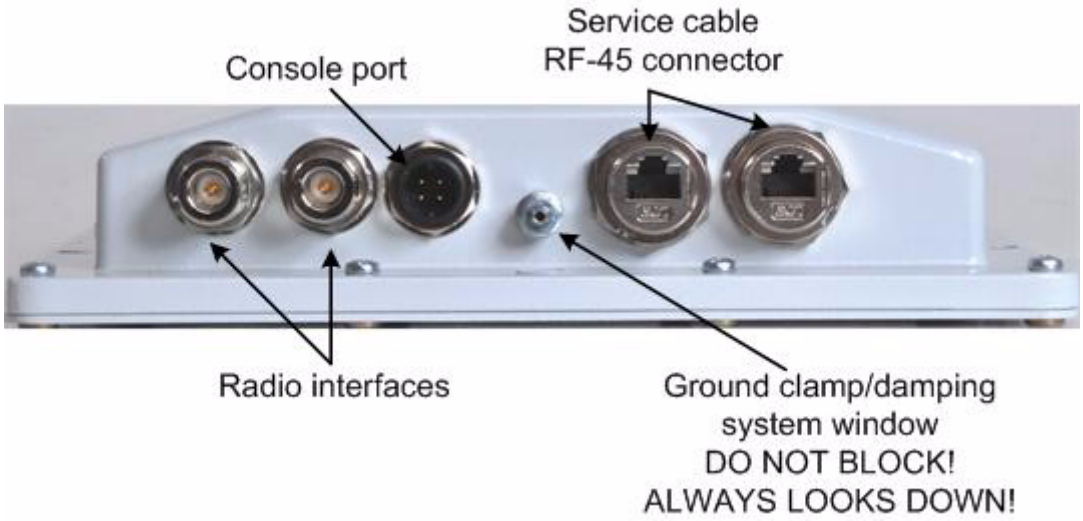


Figure 2-5: BU/RB-B300D-5X Front Panel

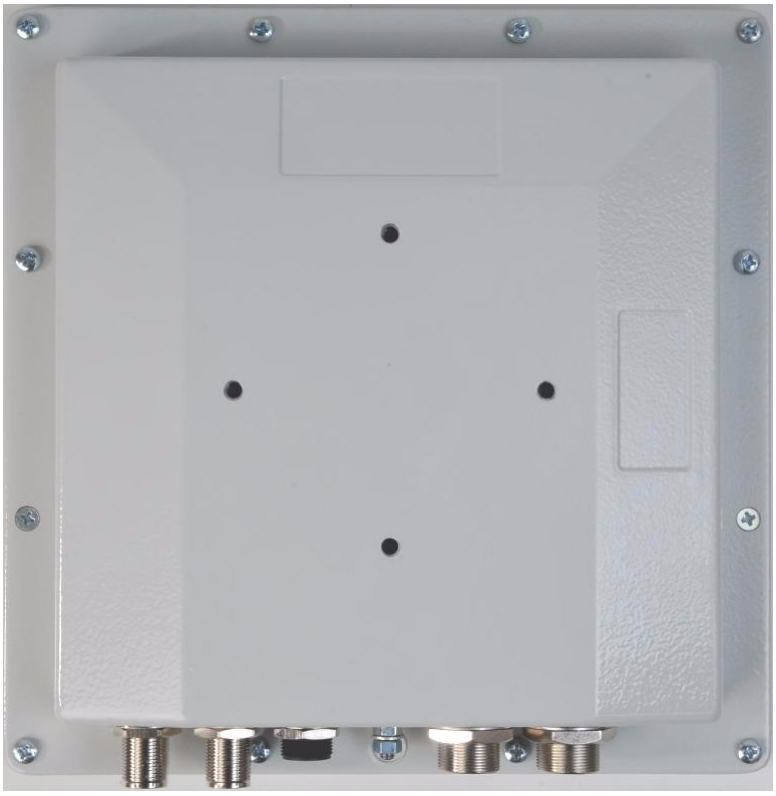


Figure 2-6: BU/RB-B300D-5X Top View

2.2.2 BU/RB-B300-5X

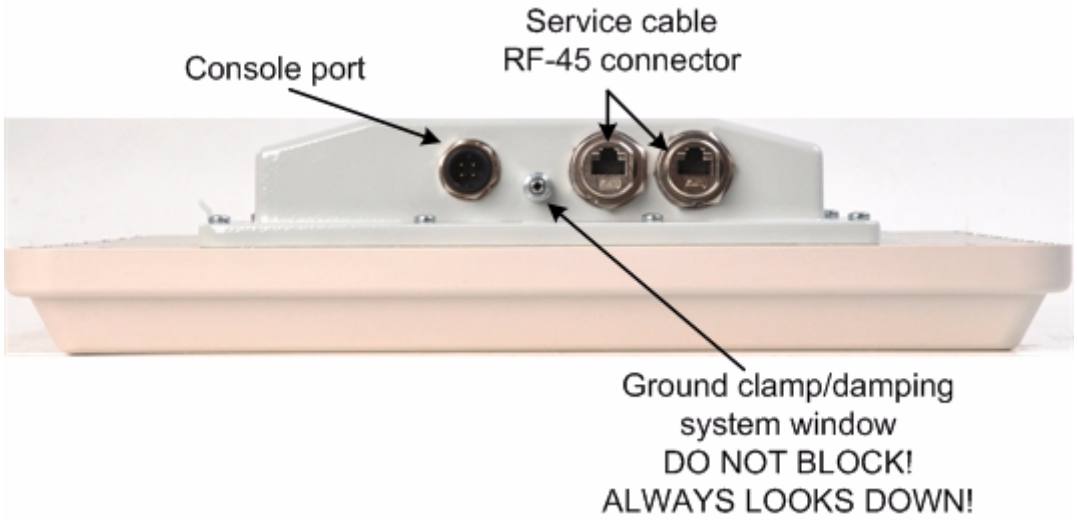


Figure 2-7: BU/RB-B300-5X Front Panel

Figure 2-8: BU/RB-B300-5X Top View

2.2.3 ODU LED Indicators Description

ODU units have two LED indicators (red and green) located in the Console connector. These LEDs are useful in monitoring the device status during the installation procedure. LEDs modes and Device status correspondence is shown in the following table:

Table 2-1: ODU LED Indicators Description

Red Indicator	Green Indicator	Device Status
Off	Off	Device is switched off of in the process of start-up booting
Off	Blinking	Device is booted. No radio connection. Searching for another device to establish radio connection to.
Blinking	On	Radio connection established. The more data is transmitted through the radio channel the more frequently red indicator is blinking.

2.3 Installation Preparations

2.3.1 Required Components and Accessories

Before the installation, please make sure you have all necessary parts and accessories:

- Device
- Antenna
- Low loss antenna cable for the required frequency range
- Antenna pole (if necessary)
- Required grounding system
- Accessories and tools

2.3.2 Antenna Placement

When planning an antenna placement for PTP link, in order to obtain the maximal coverage range and best performance for the Device, one need to consider that LOS requirements must be fulfilled for the path between two antennas. Moreover, it is of vital importance that the certain zone that surrounds the signal propagation path must be free from obstructions. One should understand that the radio beam is not as thin as, for example, laser beam. Radio beam, also called as a 1st Fresnel zone, has a profile of a rugby ball. Its exact form and size depend upon the frequency and the signal propagation path length.

If most of the 1st Fresnel zone is obstructed, a major part of a electromagnetic energy will be lost which leads to a severe signal quality degradation and, as a result, to coverage range decreasing.

Below is an incomplete list of possible obstructions on the signal propagation path:

- Neighboring buildings
- Trees
- Bridges

- Power lines

To obtain the best results, it is necessary to perform a precise analysis of a signal propagation path zone and possible obstructions that may cover a part of the 1st Fresnel zone (usually the analysis is performed at the highest points of the signal propagation path).

NOTE

While planning, it is strongly recommended to consult high-qualified and experienced technicians

General recommendation for antennas placement are the following:

- Install antennas as high as possible over specific level. In case of flat surface - it will be ground level, in case of vegetation and forest - it will be tree heights, in urban environment - it will be the highest building in the observed area (specific level definition).
- Avoid tree and vegetation along with wave propagation path, influence of trees can increase depending on seasons (ice, dew, leaves);
- Proximity of other antennas should be avoided (at least 2 meters);
- Reflecting surfaces should be considered (building with reflective windows, water surfaces or wet grounds);
- When installing antenna over water surface, one should tune height bracket within 1-3 meter range variation, because it can yield signal level variation from minimum to maximum.
- If seasonal changes influence on the signal quality, so then the most probable reasons would be either the connectors are not protected enough from humidity, summer vegetation or ice covered cabling and connectors during winter.

2.3.3 Antenna Poles Usage

Antenna installation is performed on a special facility called antenna pole. The pole is used for strong antenna tightening at the installation site. Poles might have different modifications depending on the installation requirements.

2.3.4 Poles with Stretching

Usually this kind of poles are used when installing antenna on a flat surface and permits one to raise it to a significant height for providing optimal conditions for signal propagation.

2.3.5 Wall Mounted Pole

Usually these kinds of poles are used when there is no need to elevate antenna to the rooftop and there is the possibility to mounting it on a wall. This installation is significantly simpler than that implementation with poles. Mostly it is used for subscriber side deployments.

2.3.6 Antenna Poles Requirements

Ease of antenna mounting and sufficient mechanical durability should provide reliable fastening in conditions of high windy loads. Poles should have round profile for ease of azimuth adjustment. Typical pole diameter is 30 to 50 mm.

2.3.7 Grounding when Using IDU-BS

Antenna should be placed on the mast on the level that is at least 1 meter lower than a mast's top. In this case it is of big probability that the lightning strikes the mast and not the antenna. The mast is to be grounded on the grounding contour according to your local standards. When the lightning strikes the antenna, the current goes through the coaxial cable which grounds ODU clamp with the mast - the mast is grounded via the grounding contour. The direct lightning strike to the STP service cable (ODU-IDU) is partially terminated on the grounded IDU case. Partial termination means that the direct lightning strike will probably destroy an STP cable. The service cable pickups from the electromagnetic impulses are terminated on the IDU case by the winding shield, and further - on the IDU grounding. IDU is grounded via a three-conductor power cord and a plug containing a ground. The data & power wires pickups are terminated via IDU protection scheme (three-conductor power cord and a plug containing a ground).

CAUTION

Antenna pole, tower, ODU and lightning arrestor should be connected to the first common grounding contour. Cable thickness should be no less than 10AWG using corrosion-steady connectors. It is highly recommended to entrust grounding contour development to the skilled personnel.

A special attention should be paid if antenna used is not DC-shorted. In this case additional lightning arrestor should be used between the antenna and ODU. Suggested grounding diagram is shown on the picture below.

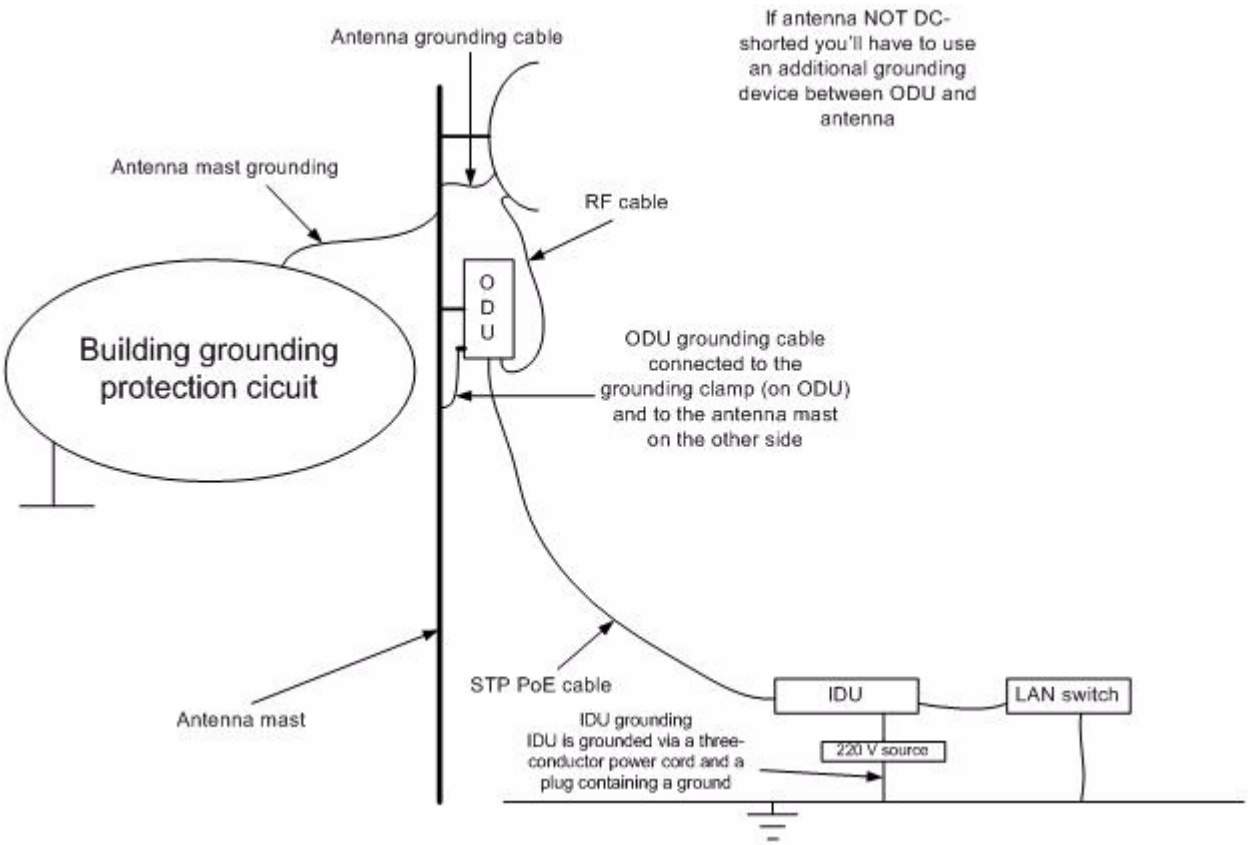


Figure 2-9: Grounding

2.3.8 Antenna Alignment

To obtain maximal system performance antennas must be precisely aligned one towards another according to LOS requirements. General recommendations for antenna alignment are the following:

- Align antennas using optical equipment (binoculars, spyglass) accompanied by mobile phone actions coordination
- Use GPS receiver and area map
- Use build-in Device features. These features allow evaluating current channel/signal quality and perform precise antenna alignment

2.3.9 Precaution Measures

Before you start the installation please read this section very carefully.

Antennas are installed on the roof tops or on the building walls. This work must be accomplished only by personnel having special skills and experience in this area.

Antennas and cables are electric conductors. Incidental electrostatic strikes may occur during the system installation. This can lead to equipment damaging or may hurt the personnel. While installing or changing the elements of the antenna-fider system one should make sure that open metal parts are temporarily grounded.

Do not install the antenna close to the electric power lines. Antenna and antenna pole have to be installed in such a way that while their assembling, disassembling and repairing they did not have any contact with power lines.

Basic precaution measures that must be fulfilled during the installation are the following:

- Do not stay on the roof top in windy or rainy weather, during the thunderstorm or when the working zone is covered with snow or ice
- Do not touch the antennas, antenna poles, cables and lighting arrestors during the thunderstorm
- Antenna placement should not be close to electric or telephone lines. Safe distance is a distance that is a sum of the two antenna poles heights and antenna height

2.3.10 Service Cable Soldering Procedure

The following instruction shows the "RJ-45" (modification 2) connector soldering procedure.

Table 2-2: RJ-45 Connector Soldering Procedure

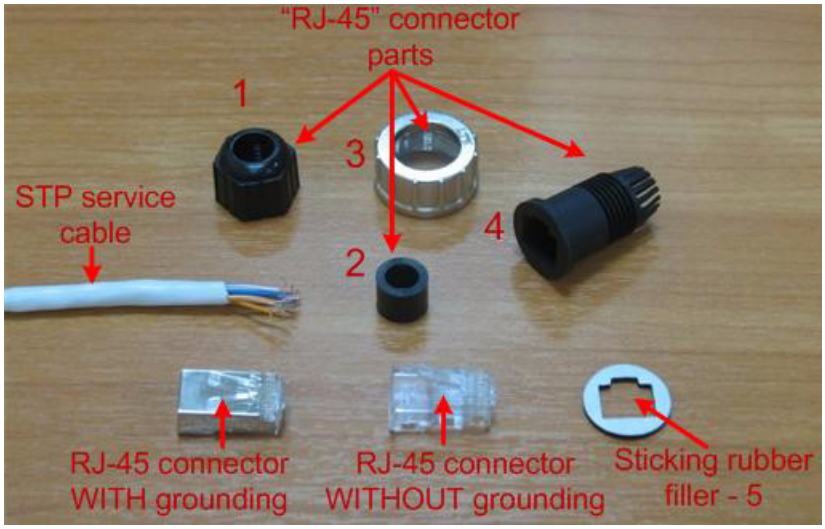
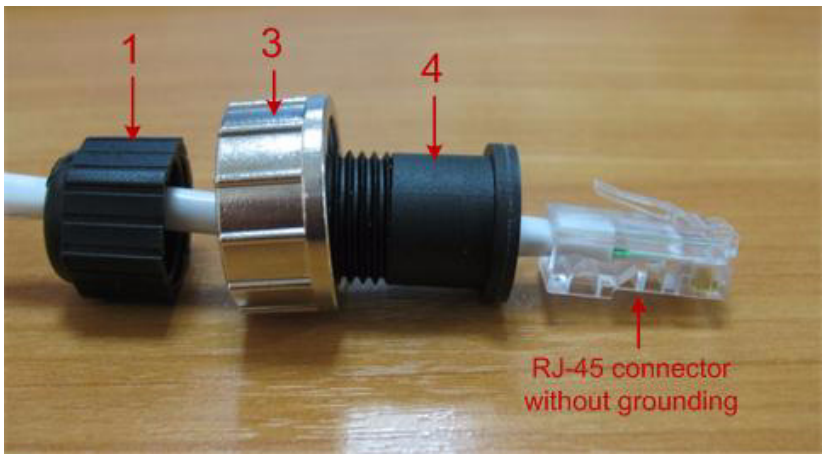
Illustration	Description
	Step 1. Peel STP service cable and prepare "RJ-45" connector parts. Use RJ-45 connector without grounding here (RJ-45 connector with grounding is used for connecting service cable to IDU).
	Step 2. Stick rubber filler - 5 on the Part 4, previously having removed protective white layer from rubber filler -5. Insert Part 2 inside part 4 up to the stop. Part 2 must be entirely within Part 4.
	Step 3. Put connector parts on the STP service cable as shown. Attach RJ-45 connector without grounding to the STP service cable according to the "RJ-45" soldering scheme and crimp the connector.

Table 2-2: RJ-45 Connector Soldering Procedure

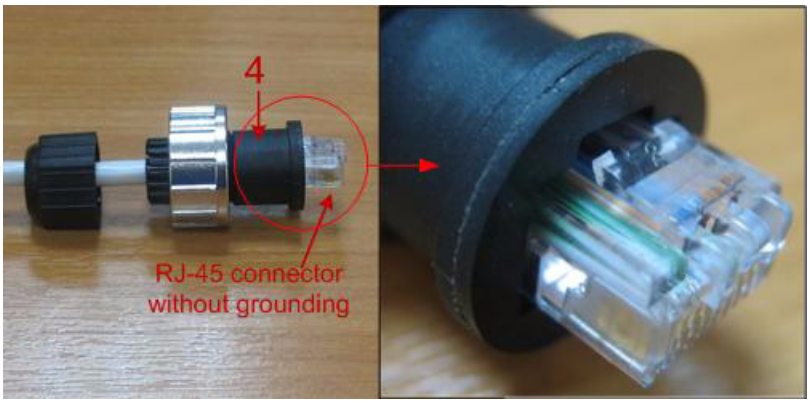
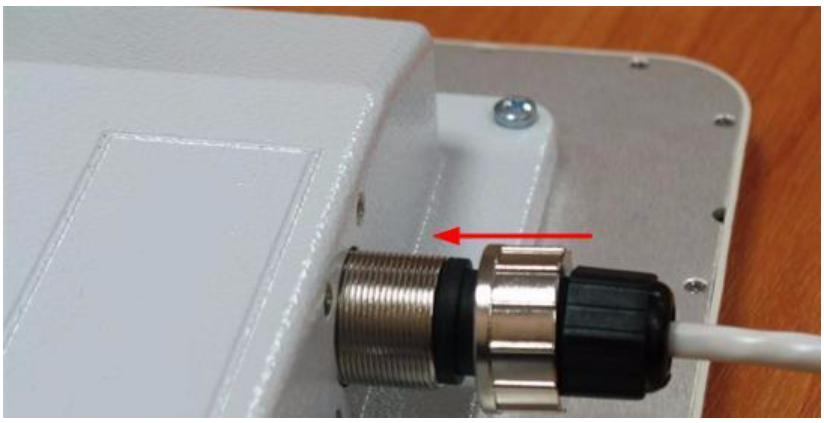
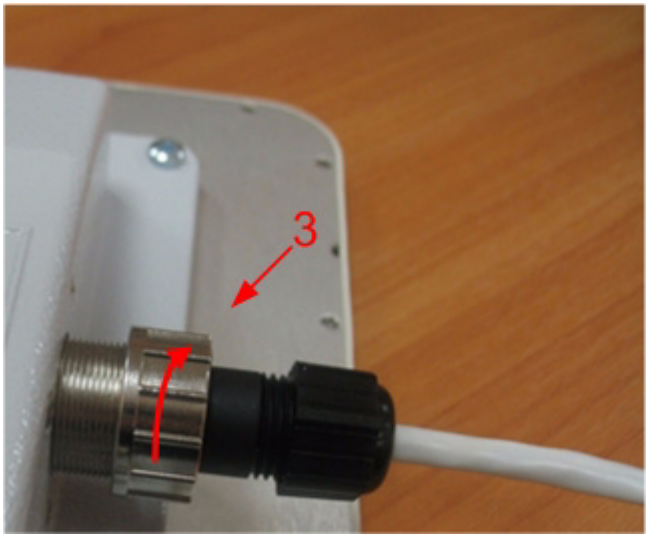
Illustration	Description
	Step 4. Put Part 4 on the attached in the previous step RJ-45 connector.
	Step 5. Screw Part 2 on Part 4. This fixes the "RJ-45" connector on the cable. Check that the connector is properly fixed on the cable.
	Step 6. Assemble the connector to the unit.

Table 2-2: RJ-45 Connector Soldering Procedure

Illustration	Description
	Step 7. Fix the connector by screwing Part 3. Now the connector is hermetically attached to the unit.

2.3.11 Tools Required at the Installation Site

1. Screwdrivers set
2. Pliers
3. Soldering iron 40 W
4. Spanners set
5. Connectors isolating set
   - Raw rubber
   - Thermal shrinkage tube
   - Scissors
   - Fan
   - Mantling gun
6. Additional equipment
   - GPS receiver or area map (with compass and alidade)
   - Big zoom binoculars

2.4 BU/RB-B300D-5X

2.4.1 Installation Guidelines

1 Unpack the equipment

2 Check items integrity

3 Prepare RF-cables of the required length. The recommended maximal RF cable length is 1 meter.

4 Install and isolate the connectors on the RF cables

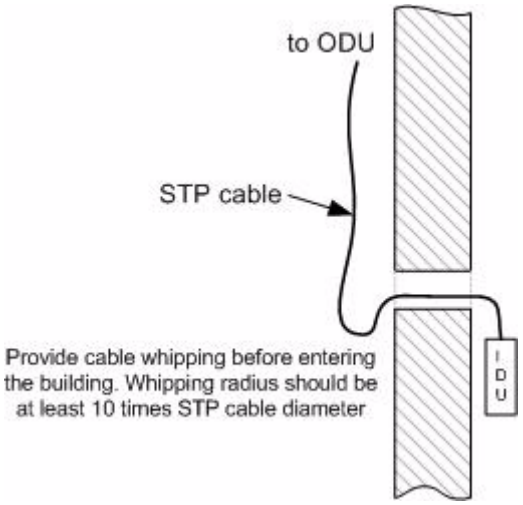


Figure 2-10: BU/RB-B300D-5X Installation 1

5 Determine the STP cable length that is used to connect IDU and ODU. The total cable length between LAN (behind IDU) and ODU should not be longer than 100 meters. Service cable connecting IDU and ODU should be STP Cat 5E cable.

6 Install (solder) connector for ODU on the STP cable and isolate it

7 If it is possible to lay STP cable with a connector on the IDU side, install (solder) connector for IDU on the STP cable and isolate it

8 Lay the STP cable "from top to bottom" - from ODU to IDU

9 If step 7 is not accomplished, after the STP cable has been laid, install (solder) connector for IDU

10 Install ODU on the mounting bracket connectors down and tighten it

11 Connect the ODU-IDU cable to the ODU

12 Isolate the ODU connector joint place

13 Once the antenna and antenna pole are installed they must be grounded via lightning protection grounding contour. Antenna's position must be lower than the highest antenna pole point at least by 2 antenna heights. If antenna is NOT DC-shorted (see antenna technical documentation), the additional lightning arrestor must be used which is placed between ODU and antenna and is grounded to the antenna pole grounding contour.

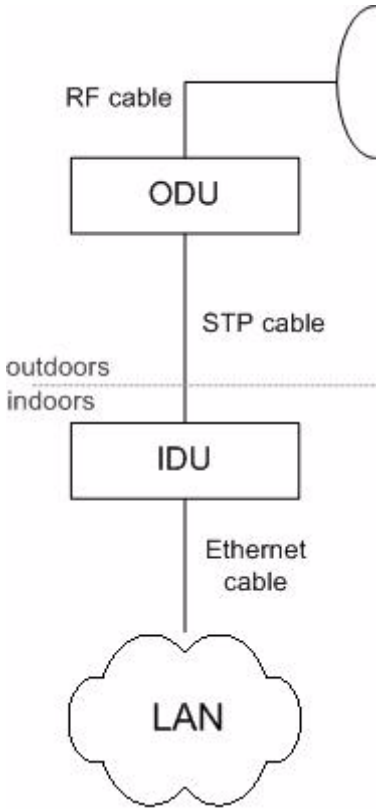


Figure 2-11: BU/RB-B300D-5X Installation 2

14 Connect RF cables to the antenna. Twist the connectors tightly

15 Connect RF cables to the ODU previously having touched RF cable connectors case with ODU connector case

16 Isolate RF connectors from both sides (ODU and antenna)

17 Connect the STP cable to IDU previously having touched IDU connector case with STP cable connector case

18 Provide grounding for IDU

19 Connect Ethernet cable to IDU

20 Provide power supply for IDU

21 Connect to the Device using Telnet protocol

CAUTION

It is extremely important to install ODU connectors down!

2.4.2 Tube Mounting for ODU

Figure 2-12: Tube Mounting 1

Figure 2-13: Tube Mounting 2

2.5 BU/RB-B300-5X

2.5.1 Installation Guidelines

1 Unpack the equipment

2 Check items integrity

3 Determine the STP cable length that is used to connect IDU and ODU. The total cable length between LAN (behind IDU) and ODU should not be longer than 100 meters.

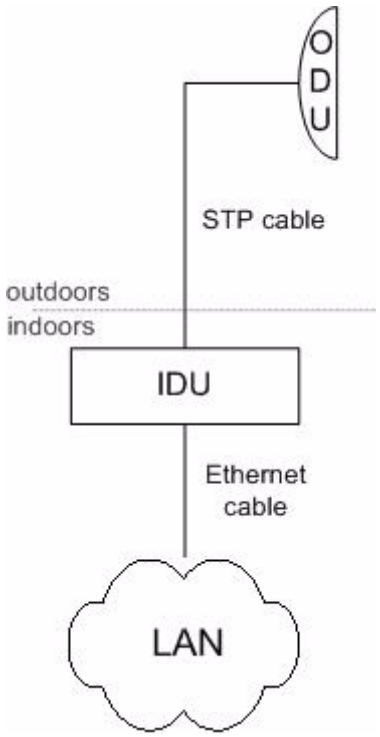


Figure 2-14: BU/RB-B300-5X Installation 1

4 Install (solder) connector for ODU on the STP cable and isolate it

5 Lay the STP cable "from top to bottom" - from ODU to IDU

6 After the STP cable has been laid, use distribution box to switch from STP cable to UTP cable with RJ-45 connectors. Service cable connecting IDU and ODU should be STP Cat 5E cable.

7 Install ODU on the mounting bracket according to the direction required for the link. Do not tight it too hard unless the antenna alignment is not complete. Install ODU connectors down.

8 Connect the ODU-IDU cable to the ODU

9 Isolate the ODU connector joint place

10 Once the ODU and antenna pole are installed they must be grounded via lightning protection grounding contour. ODU position must be lower than the highest antenna pole point at least by 2 ODU heights

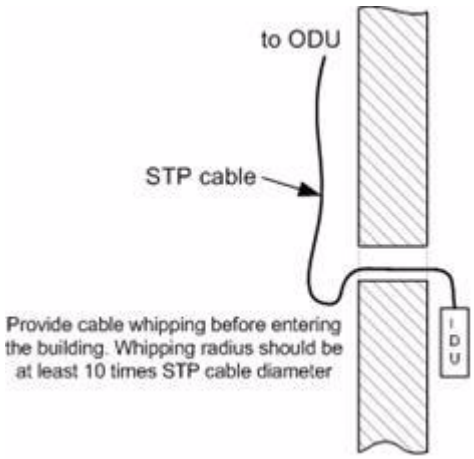


Figure 2-15: BU/RB-B300-5X Installation 2

11 Connect the UTP cable to IDU

12 Provide grounding for IDU

13 Connect Ethernet cable to IDU

14 Provide power supply for IDU

15 Connect to the Device using Telnet protocol

CAUTION

It is extremely important to install ODU connectors down!

2.5.2 Pole Mounting Kit Assembling

Figure 2-16: Pole Mounting Kit Assembling 1

Figure 2-17: Pole Mounting Kit Assembling 2

2.6 Mounting Kits Assembling

2.6.1 Pole Mounting Kit MONT-5000-V.Pole-KIT for Vertical Mast

CAUTION

Attention! Pole mounting kit MONT-5000-V.Pole-KIT does NOT contain metal straps.

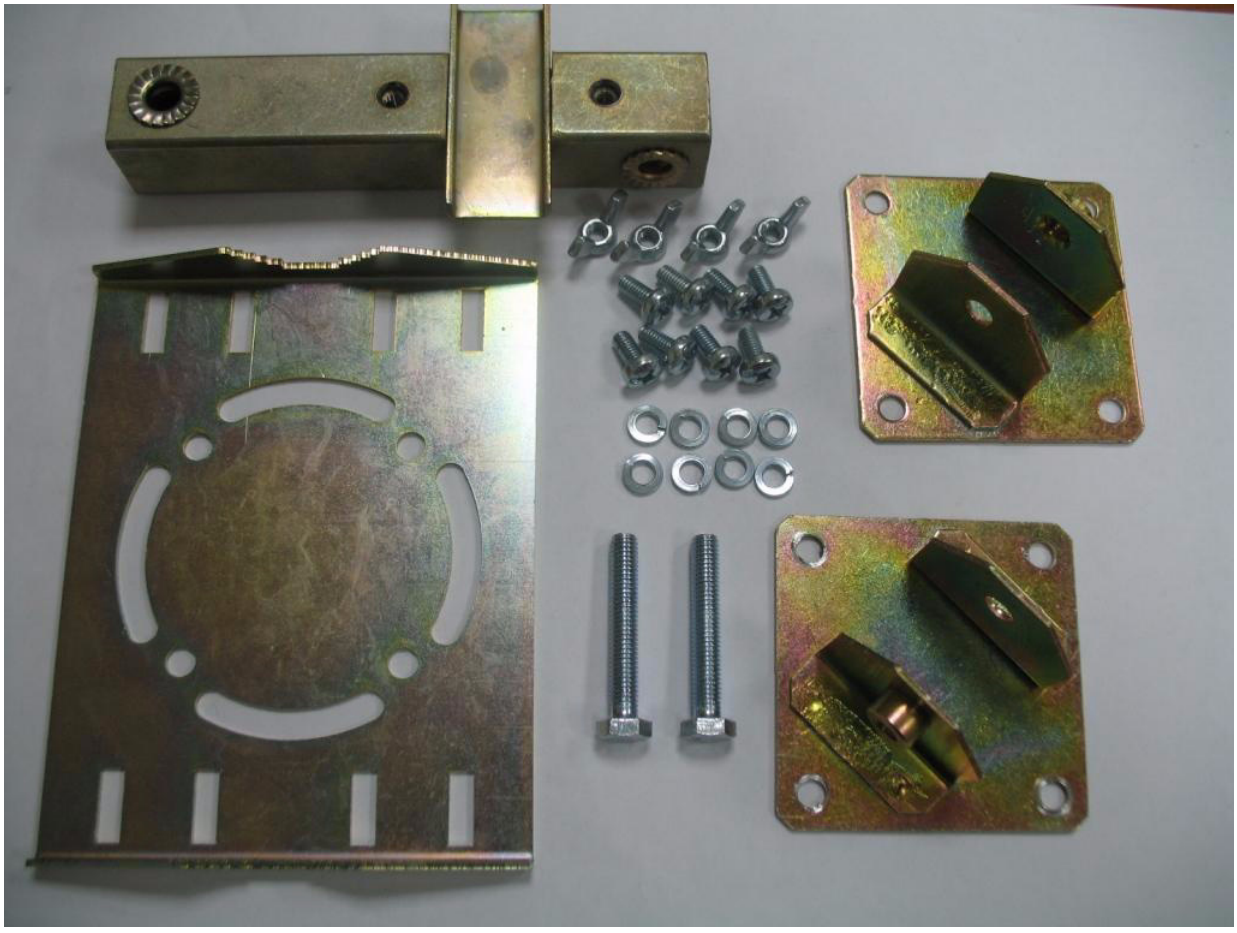


Figure 2-18: MONT-5000-V.Pole-KIT 1

Figure 2-19: MONT-5000-V.Pole-KIT 2

2.6.2 Pole Mounting Kit MONT-5000-H.Pole-KIT for Horizontal Pole

CAUTION

Attention! Pole mounting kit MONT-5000-H.Pole-KIT does NOT contain metal straps.

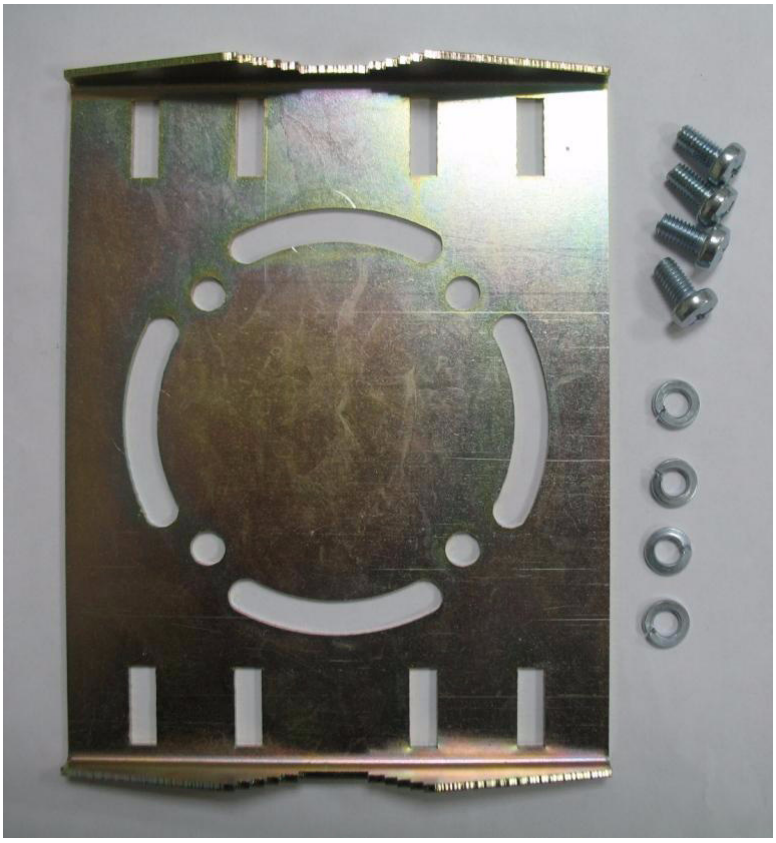
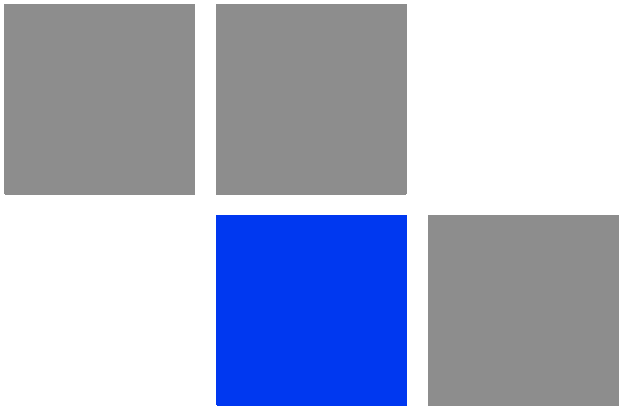


Figure 2-20: MONT-5000-H.Pole-KIT 1

Figure 2-21: MONT-5000-H.Pole-KIT 2



Chapter 3

Basic Configuration Instructions

In This Chapter:

3.1 Initial Settings Configuration Procedure

Before starting new device, one should perform initial configuration. The configuration can be performed either using serial console port or using Telnet protocol. In order to configure the device using Console port, follow the instructions below:

- Device should be connected with host .g. Hyper Terminal)
- Set serial interface properties to 38400 baud rate, 8 bit, 1 stop bit, parity off, flow control disabled
- Enable emulation mode ANSI or VT100, keyboard VT100

To connect using Telnet protocol from the wired LAN run Telnet with 10.10.10.1 IP-address that is configured for the Ethernet interface of the device by default.

If all above procedures are completed correctly, you will see the WanFlex OS prompt:

```
Login:
```

Every new device has got default login and password settings as written below:

```
Login: admin
Password: private
```

After default authorization there will be standard console prompt:

```
console>
```

Now the device is ready for the initial configuration procedure. The most relevant thing to be done at this phase is to define device name/user/password.

```
system name Test
system user root
system password qwerty
```

NOTE

Part of commands in **bold** must be typed in CLI (Command Line Interface). The rest of the command name is optional and can be skipped while typing.

3.2 Device Interfaces

The Device has several physical and logical interfaces:

- **lo0** - loopback interface, used for system interaction needs
- **null0** - logical interface, can be used for auxiliary addresses assignation (for NAT module, for example); for routes aggregation for RIP protocol. Addresses (subnet) are announced to the network but every packet transmitted through this interface is destroyed
- **eth0** - First Ethernet 10/100 Mbit interface
- **eth1** - Second Ethernet 10/100 Mbit interface
- **rf5.0** - radio interface. See device's labeling it learn your radio interface name
- **vlanX** - interfaces supporting VLAN 802.1q tagging

All configured interfaces of the device can be reviewed using the following command:

```
ifconfig -a
```

3.3 Command Line Interface (CLI)

For device's management and configuration a Unix-like command line language is used. Every command starts having the power right after Enter key is pressed. However, each command lifetime duration is limited within one configuration session. In order to save a current configuration "config save" command is used.

Several commands can be grouped in one line using ";" character. If a wrong-syntax line is met in the group, the rest of the string is checked anyway and the wrong command is ignored. Command name can be shortened unless the ambiguity occurs.

If your terminal supports VT100 or ANSI standard you can move around the list of recently executed commands using cursor keys. Numbered list of these commands can be reviewed by "**!h**" command. Any command from this list can be available using "**!<NUMBER>**" command. TAB key performs substring search of recently executed commands.

Ctrl/R combination refreshes the command string if its content was disturbed by system messages.

The command executed with no arguments prints a short hint about its keys, parameters and syntax.

Context help can be obtained by printing "**?**" in any position of the line.

3.4 Lost Password Recovery

The password for the device can be recovered remotely.

Recovery procedure can be done with the help of graphical "ERConsole" utility.

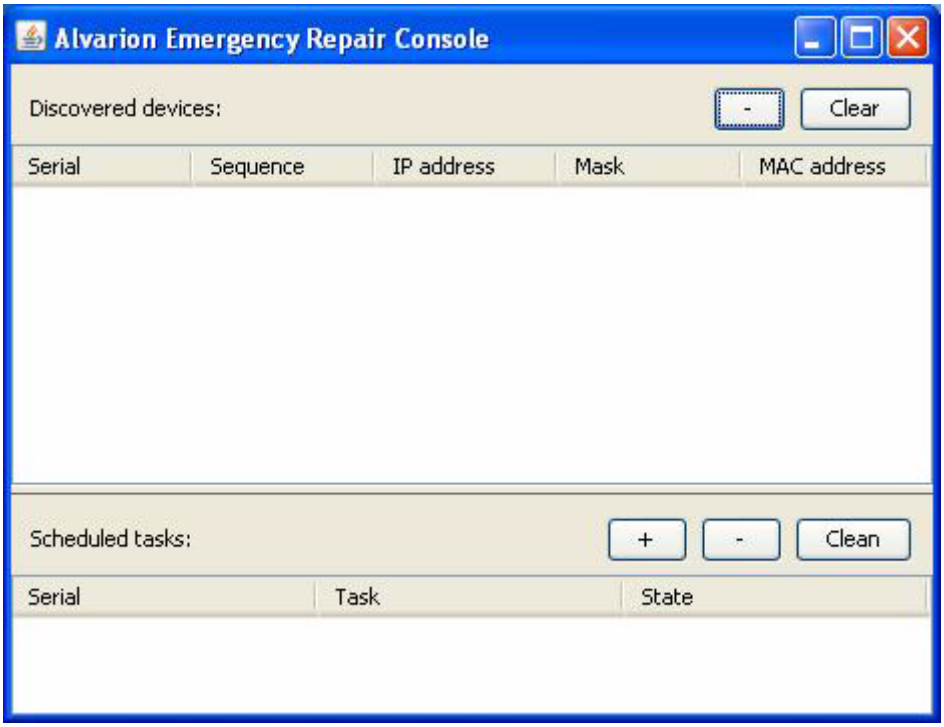


Figure 3-1: ERConsole (Step 1)

Below is a description of ERConsole's utility recovery procedure:

1 Connect a computer and a device that should be repaired to one physical Ethernet segment.

2 Start the ERConsole utility on the computer by running the ERConsole.jar file.

Utility will be running in a waiting mode.

3 Restart the device. During its restart, the ERConsole utility will determine the device and will show necessary information about it in the "Discovered devices" section of the main window.

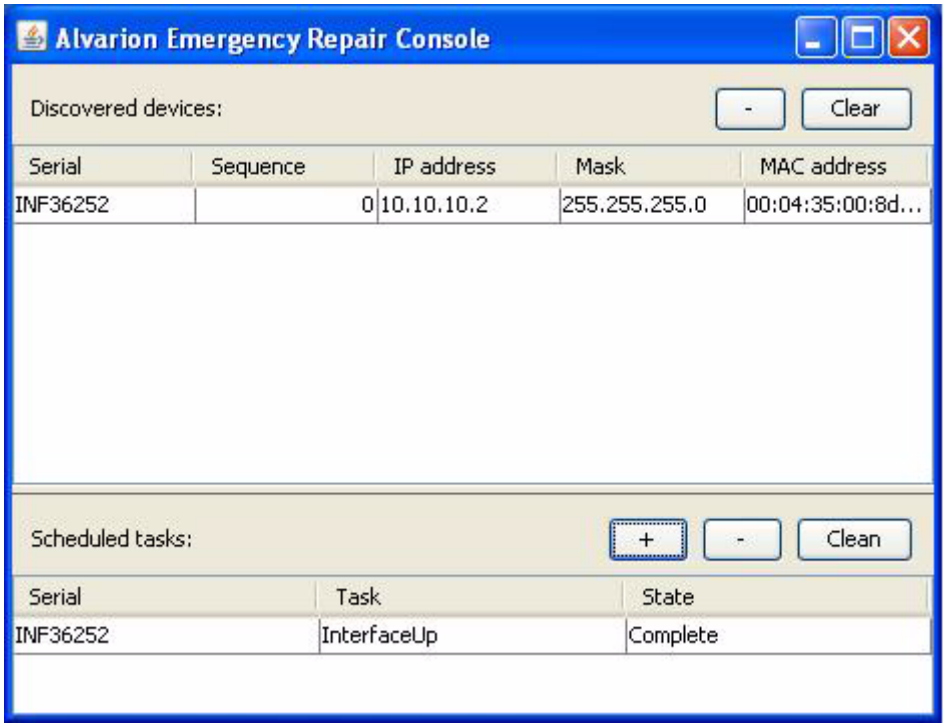


Figure 3-2: ERConsole (Step 2)

4 Send "Serial" and "Sequence" fields values to the Technical Support.

5 You will be given a factory password for the device.

6 Click the "+" button in the "Scheduled tasks" section of the main window.

7 In the opened "New task" window choose "Reset configuration" in the "Command" field. Then enter Serial number and factory password in the corresponding fields. Click "Ok".

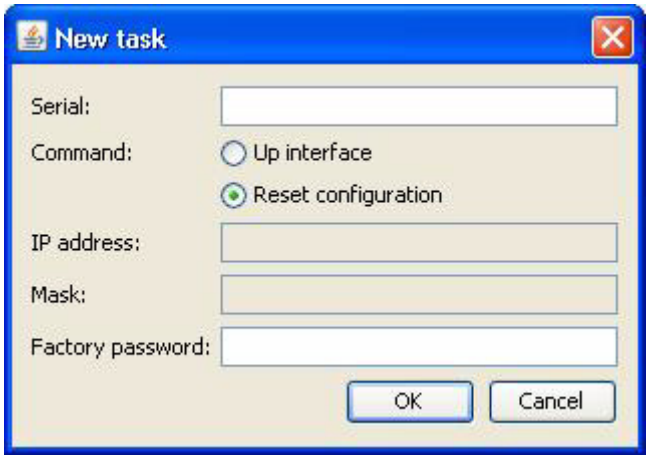


Figure 3-3: ERConsole (Step 3)

8 Restart the device.

After device restart the ERConsole utility will reset device configuration.

9 Login the device with Serial number as a login name and new password that was received from tech support.

10 Reconfigure device username and password.

ERConsole utility's "New task" window also allows changing device's IP-address on its Ethernet interface (eth0) without login to device.

3.5 Configuration Manipulations

3.5.1 Printing and Saving Your Configuration

You can easily review your current device's configuration by executing "**co**nfig **sh**ow" command. The output of the command is sorted by the configuration sections (e.g. "System parameters", "Interfaces configuration" etc).

You can review some particular parts of the configuration specifying the part of the configuration you want to see.

Example:

```
config show ifc
```

This command will print the interfaces configuration.

In order to save your configuration "config save" command is used. It saves the current system configuration in the device's flash memory for subsequent permanent use. All modifications to the system parameters, if not saved by this command, are valid only during the current session (until the system reset occurs).

3.5.2 Import/Export

Export/import of the device's configuration is performed using "**co**nfig **ex**port" and "**co**nfig **im**port" commands correspondingly. "**Co**nfig **ex**port" saves the device configuration on a remote server and "**co**nfig **im**port" reloads it from a remote server. The information is transferred using FTP.

Example:

```
config export user:secret@192.168.1.1/var/conf/test.cfg
```

"**Config import**" command writes the uploaded file directly into the Flash memory without changing the active configuration in RAM. In order to make a new configuration active, right after "**config import**" command implementation finishes the device should be rebooted. If "**config save**" command is run before rebooting, Flash memory is overwritten by the copy of the active configuration. This action will erase the uploaded configuration file.

3.5.3 IP Address Formats

Many commands of the operating system require specification of IP addresses.

In OS WANFleX, the IP-addressees may be specified in traditional numeric format. Optionally, the mask may be specified either by its bit length (the specified number of leading bits in the mask are set to 1, the remaining bits are reset to 0) or numeric value. The IP address 0/0 denotes all possible IP addresses.

Therefore, the possible formats to specify IP-addresses are:

nn.nn.nn.nn (no mask is used)

nn.nn.nn.nn/N (N is the bit length of the mask)

nn.nn.nn.nn:xxx.xxx.xxx.xxx (xxx.xxx.xxx.xxx is the numerical value of the mask)

Example:

The 192.168.9.0/24 address describes the network address 192.168.9.0 and the mask with leading 24 bits on.

The same set of addresses may be denoted as 192.168.9.0:255.255.255.0.

3.6 Ethernet Interface Configuration

In the most basic form Ethernet interface can be configured as follows:

```
ifconfig eth0 1.1.1.1/24 up
```

UP flag means than the interface is turned to UP state.

Also you can specify the following parameters for the Ethernet interface:

- Media type. By default media type is selected automatically (**media auto** parameter).
- Assign aliases to the Ethernet interface (**alias** key word)

Full information about interfaces configuration can be reviewed in OS WanFlex User Guide - **ifconfig** command.

3.7 Radio Interface Configuration

Radio interface configuration is performed using "**rfconfig**" command. In its most basic form one need to configure the following parameters of the radio interface:

- Frequency (**freq** parameter) in MHz. For example, 5260.
- Bit-rate (**bitr** parameter). Bit transfer rate in kBits/sec.
- System identifier (**SID** parameter). A hexadecimal number in the range of 1H to FFFFFFH. All devices that are supposed to see each other on the same radio link must have the same identifier.

NOTE

Radio interface state is not saved in the configuration. That means that if you put radio interface to the **down** state after rebooting it will be in the **up** state.

To learn your device's radio module capabilities type the command:

```
rfconfig <IF-NAME> capabilities
```

<IF-NAME> - radio interface name. Can be read on the device's labeling located on the case.

Radio interface configuration is performed using "**rfconfig**" command.

Example:

```
rfconfig rf5.0 freq 5260 bitr 130000 sid 01010101
```

Additional important parameters and settings for the radio interface:

- **rf5.0** - radio interface name in this case. In order to obtain radiointerface name either see the ODU/Device labeling or execute "**ifc -a**" command.
- **pwr** - transmitting power selection. Available power levels can be obtained using "**cap**abilities" parameter as shown above
- **distance**: this parameter is used to set the exact distance value between two devices (in kilometers). This parameter changes time values for some delays

and time-outs thus making possible to work on longer distances with smooth adjustment.

There are several ways to manage this parameter:

- If you set an exact value, this value is used no matter what the connection method is used
- If the device has auto value instead of a number (by default), the device will configure its parameters automatically. While configuration showing, there might be the current distance value after **auto** parameter: **auto (XX)**. Auto mode is recommended to be used
- If **distance** parameter is set to 0 radio module will work on the distances from 0-3 km.

Example:

```
rfconfig rf5.0 freq 5260 bitr 300000 sid 10203040
rfconfig rf5.0 pwr 63 distance auto
```

Chapter 4

Link Configuration

In This Chapter:

4.1 Link Diagnostic Tools

4.1.1 Ltest

Ltest utility allows precise test of a radio link. It is recommended for antenna alignment when installing a new device or for testing of existing radio link.

Ltest can work in standard, alignment and bandwidth modes.

Standard mode:

In standard mode Ltest measures signal levels, retries, lost packets and acks.

To start Ltest in this mode:

```
ltest rf5.0 <Mac-address of a device on the other side of the radio link>
```

When "**ltest**" command starts it will show you output information that contains testing results. You can see Ltest output below:

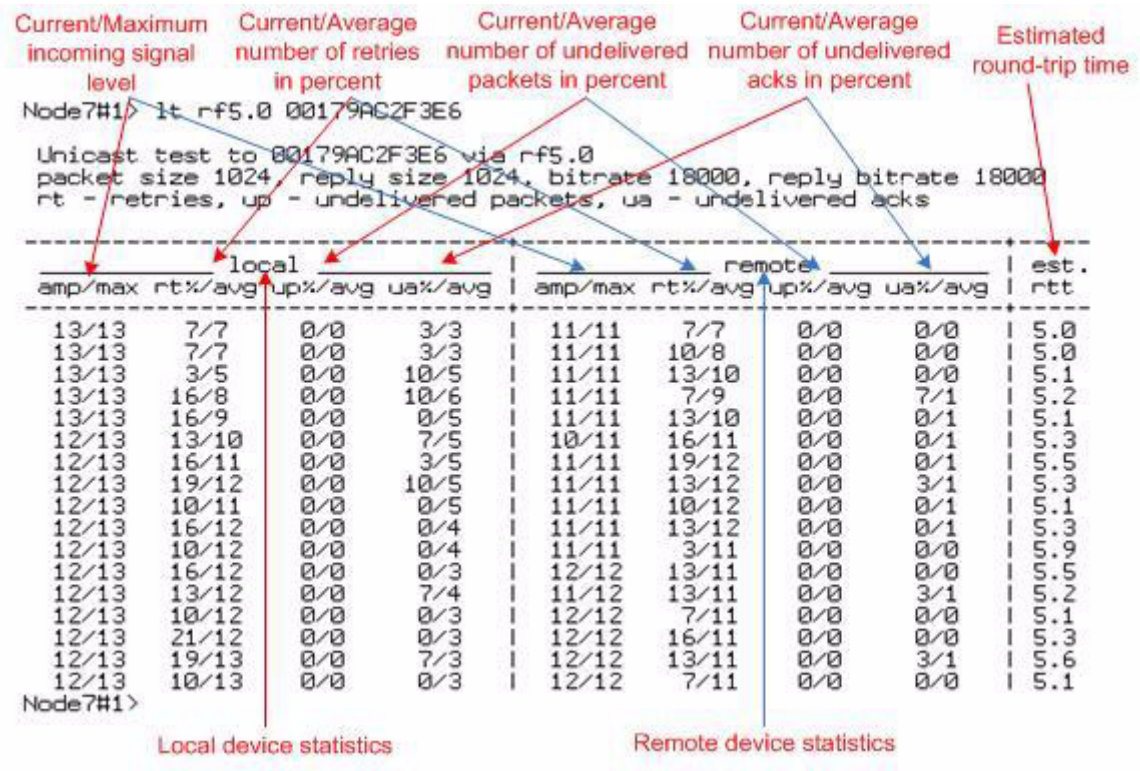


Figure 4-1: Ltest

For successful radio link establishing the following factors have to be considered:

1. It is recommended to start antenna alignment with searching maximum signal level on a minimal possible bitrate. Afterwards automatic MINT mechanisms will set the most appropriate bitrate if **autobitrate** mode will be enabled.
2. Current incoming signal level in "amp/max" columns (see "ltest" command output) must be between 12 and 40.

   When it is more than 40 it is recommended to lower amplifier power.

   If maximal signal level is less than 12 it is recommended to lower bitrate or channel width (for example, from 20MHz to 10MHz on the both sides of the radio link).

   In some cases signal level that is less then 12 may be enough for radio link operation. In this case one has to be guided by such parameters as number of retries, number of undelivered packets and number of undelivered acks. If the number of undelivered packets and the number of undelivered acks is null, the number of retries is small and all these parameters are constant in time then the radio link, most often, will be operating properly.
3. Number of retries value in "rt%" columns must be as close to zero as possible.
4. Number of undelivered packets value in "up%" columns must be zero; if this value is not zero then the radio link couldn't be exploit.
5. Number of undelivered acks value in "ua%" columns must be zero; if this value is not zero then the radio link couldn't be exploit.

ALL described parameters must be observed in the both (**Local** and **Remote**) sections of the "**ltest**" command output.

Alignment mode:

The difference of this mode from the standard one is that "ant.amps" column is used instead of "amp/max". "Ant.amps" column indicates signal levels for each of two antennas of a devce divided by ":" correspondingly.

To start Ltest in this mode:

```
ltest rf5.0 <Mac-adress> -align [N,R]
```

Ltest output in alignment mode:

```
Unicast test to 000E8E1DF5E1 via rf5.0 with no priority
packet size 1024, reply size 1024, align, tx antennas: local(0), remote(1)
rt - retries, up - undelivered packets, ua - undelivered acks

-----------------------------------+-----------------------------------+-----
____________ local _____________   | ____________ remote _____________ | est.
ant.amps rt%/avg up%/avg ua%/avg   | ant.amps rt%/avg up%/avg ua%/avg  | rtt
-----------------------------------+-----------------------------------+-----
14:43:00   0/0     0/0     0/0     | 44:15:00   0/0     0/0     0/0     | 6.6
```

Figure 4-2: Ltest Align

Bandwidth mode (Bandwidth meter):

Bandwidth meter is used to test the following radio link characteristics: speed in kilobits per second, speed in packets per second, number of retries and errors.

Use the following "ltest" command options for testing:

- **-tu [seconds]** - Unidirectional test: packets are transmitted only from the current side to the specified address ("target" option)
- **-tb [seconds]** - Bidirectional test: packets are transmitted in both directions

"Seconds" parameter allows setting test period (5 seconds by default). Maximum value is 60 seconds.

To start Ltest in this mode:

```
ltest rf5.0 <Mac-adress> -tb
```

"Ltest" command output in Bandwidth meter mode:

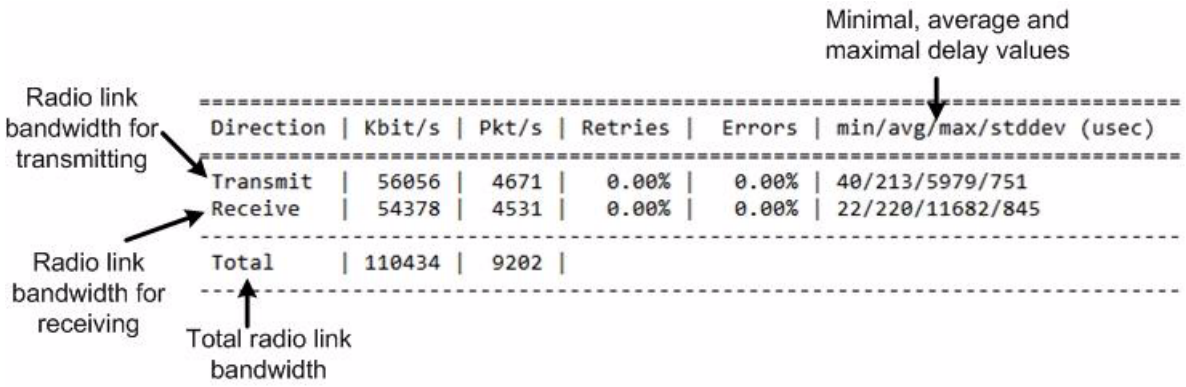


Figure 4-3: Ltest Bandwidth Meter

4.1.2 Muffer

The **muffer** module makes it possible to rapidly test the electromagnetic environment, visually estimate the efficiency of the utilization of the air links, reveal sources of interference, and estimate their power.

Several operating regimes of the **muffer** module provide for different levels of details in test results

4.1.2.1 Review Mode

This regime is enabled by the review option. It makes possible to have a general estimation of emissions and interference within specified frequency range.

NOTE

Normal operation of the radio is not possible in this mode.

This regime can be useful on the first steps of link configuration. One can observe the activity on the selected list of frequencies and make decisions of what frequencies can be used for the link so that the link did not interfere with other sources of signals.

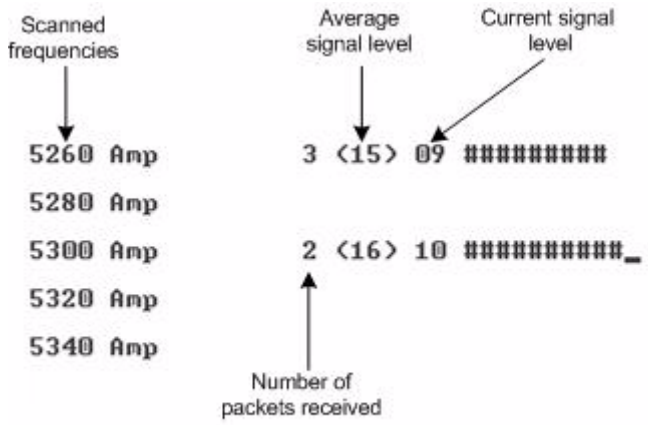


Figure 4-4: Muffer Review Mode

The picture above shows the output of **review** mode.

To run the **review** mode please type the following command:

```
muffer <IF-NAME> review
```

Once the link is established you can use this mode to review the activity on the configured for frequency for the link. If no activity is observed that means that the signal from the remote side is being broken by the interference sources or by the obstacles on the signal propagation path.

4.1.2.2 MAC2 Mode

This regime performs MAC-address analysis to estimate the efficiency of utilization of the air link. The analysis is carried out at the frequency previously specified by rfconfig command. The **mac2** regime checks both data packets and the link-level ACK messages sent by protocol supported devices.

NOTE

Normal operation of the radio is not possible in this mode.

The picture below shows the output **mac2** regime.

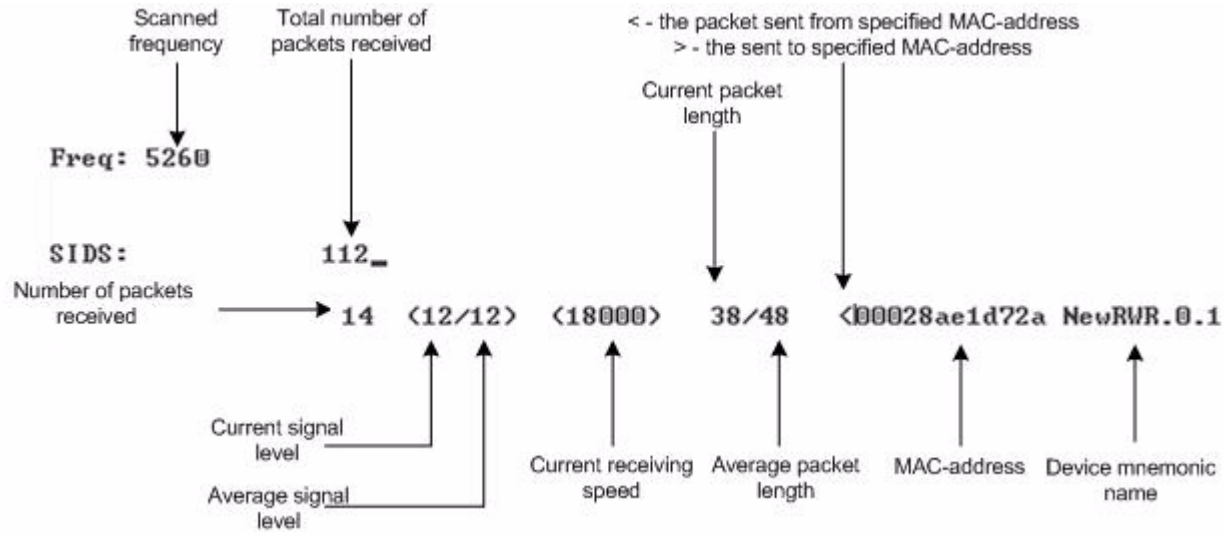


Figure 4-5: Muffer MAC2 Mode

Like in review mode this regime provides with the information about a current activity but on the configured frequency.

To run the **review** mode please type the following command:

```
muffer <IF-NAME> mac2
```

4.1.2.3 Statistics

The statistics gathering is used for estimating link load intensity. The amount of packets sent and received, and the number of retransmissions is shown for each MAC address participating in the data exchange.

The statistics output is presented in the picture below.

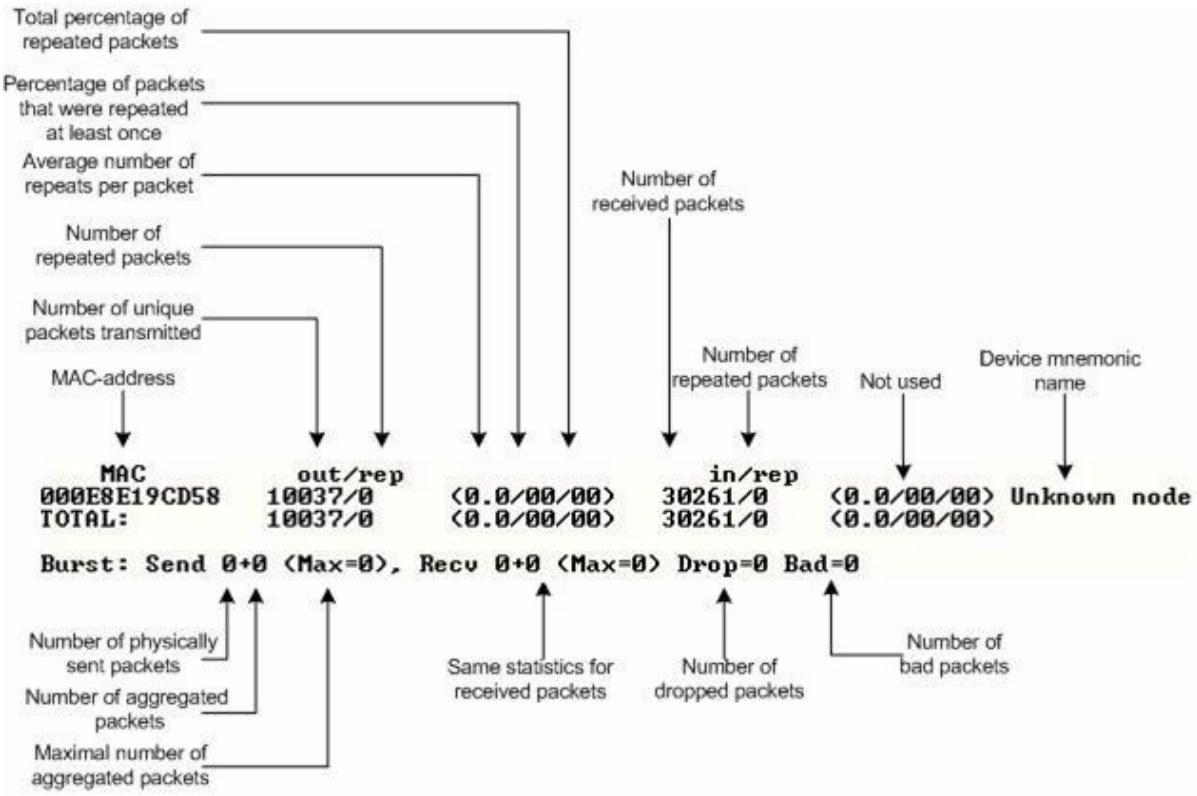


Figure 4-6: Muffer Statistics Mode

The following decisions can be made by analyzing the outputted parameters:

- If the number of repeated packets is comparable with total number of packets that means that you might have an interference source on the selected frequency. For normally operating link the percentage of repeated packets should not exceed 10%. It is extremely important to obtain a permanent zero value for the average number of repeats per packet. If the value is not zero that means that the link is NOT working properly and requires further improvement

- If total percentage of repeated packets and the percentage of packets that were repeated at least once are close to each other that might mean that you have

got a permanent source of interference. Otherwise, it means that a strong interference source appears from time to time breaking your signal

- Concerning the fact that statistics module outputs the information for each MAC-address separately, you can reveal the problem for some specific unit on the wireless network

The "**muffer stat**" command shows the statistics only from registered devices.

To view **statistics** type the following command:

```
muffer stat
```

To reset all counters please type

```
muffer stat clear
```

4.1.2.4 Other Modes of Muffer

The **muffer** also has the following modes:

- **mac** mode. Compared to the **mac2** mode this mode does not take link-level ACK messages sent by protocol support devices into account
- **mac2** mode. This mode is used to detect impulse interference and doesn't disturb radio model normal operation.
- **mac3** mode. Compared to mac2 mode this mode also performs calculation of impulse interference.
- **mynet** mode. This mode performs the radio testing without disturbing radio module's normal operation, but taking into account only packets from within the given network
- **sid** mode. The **sid** regime allows estimating the number of currently operating subscriber groups having different identifiers (SID), and the efficiency of air links utilization. The analysis is carried out for all network identifiers at the frequency previously specified for the radio module by **rfconfig** command.
- **Sensor** mode. In this mode shows the radio environment testing results on the screen in a visual-digital format.

4.1.3 Load Meter

Load meter is a powerful tool that allows estimating the load of a system interface specified by interface parameter. By default, the information is displayed on one line and updated every second; the load is measured in kilobytes.

Below picture shows the load meter output for the radio interface outputted in line-by-line mode with one second interval.

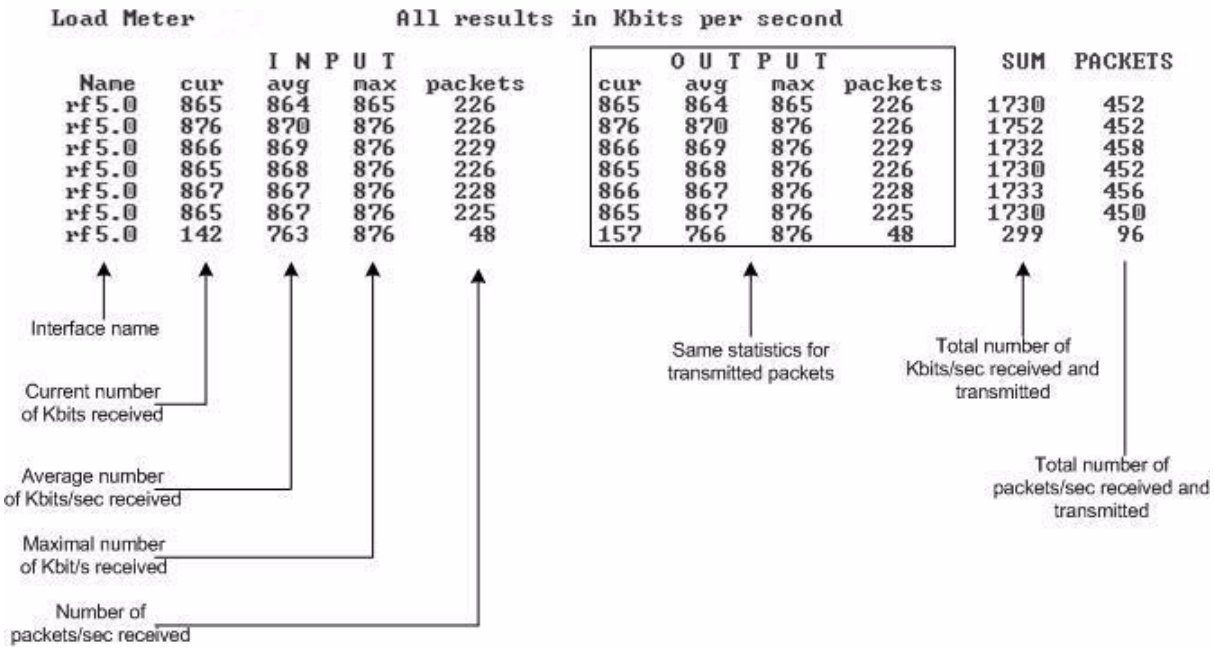


Figure 4-7: Load Meter

To run load meter like it is shown above, please type:

```
loadm -l <IF-NAME>
```

4.1.4 Acquiring Interfaces Statistics

Interface statistics can be acquired using **netstat** module which includes two modes:

- Routing tables output (using "-**r**" parameter with the command)
- Interfaces statistics output (using "-**i**" parameter with the command)

Below picture shows the example of interfaces statistics output.

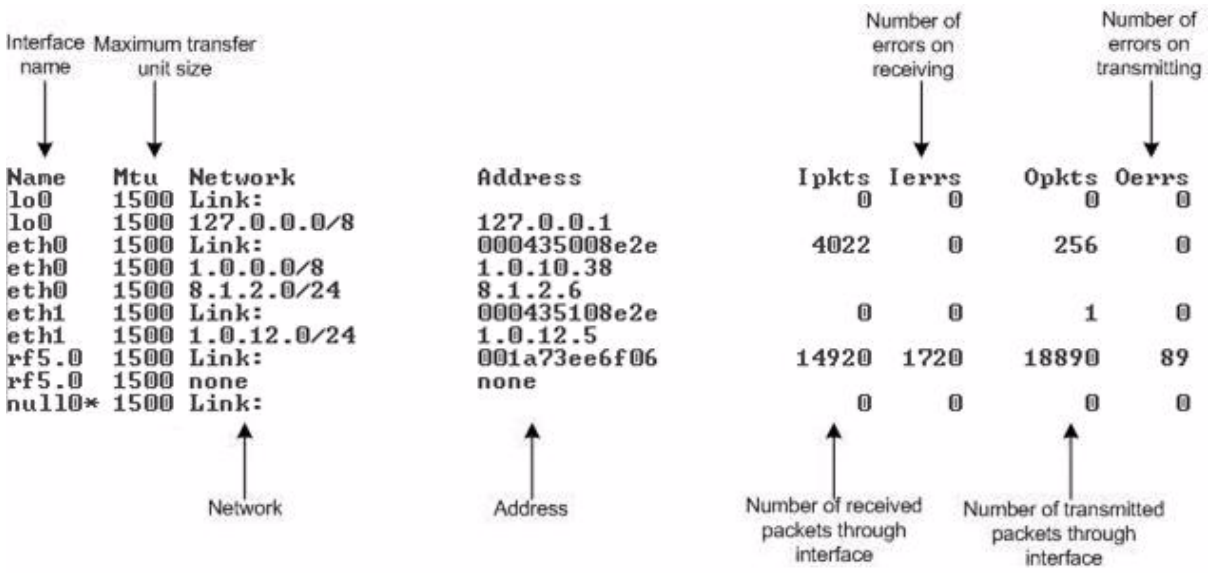


Figure 4-8: Netstat

NOTE

If the interface has several aliases the statistics is still measured for physical interface in a whole. For example, see rf5.0 or eth0 interfaces above. The numbers shown in 4 right columns correspond in physical interface.

4.1.5 RapidView

RapidView - is a special diagnostic device that is used for equipment comfort installation, antenna alignment and configuration.

Device allows getting the following information:

- Radio link establishment indication
- Visual monitoring of radio signal levels
- Receiving retries information
- Diagnostic of RF and Ethernet interfaces

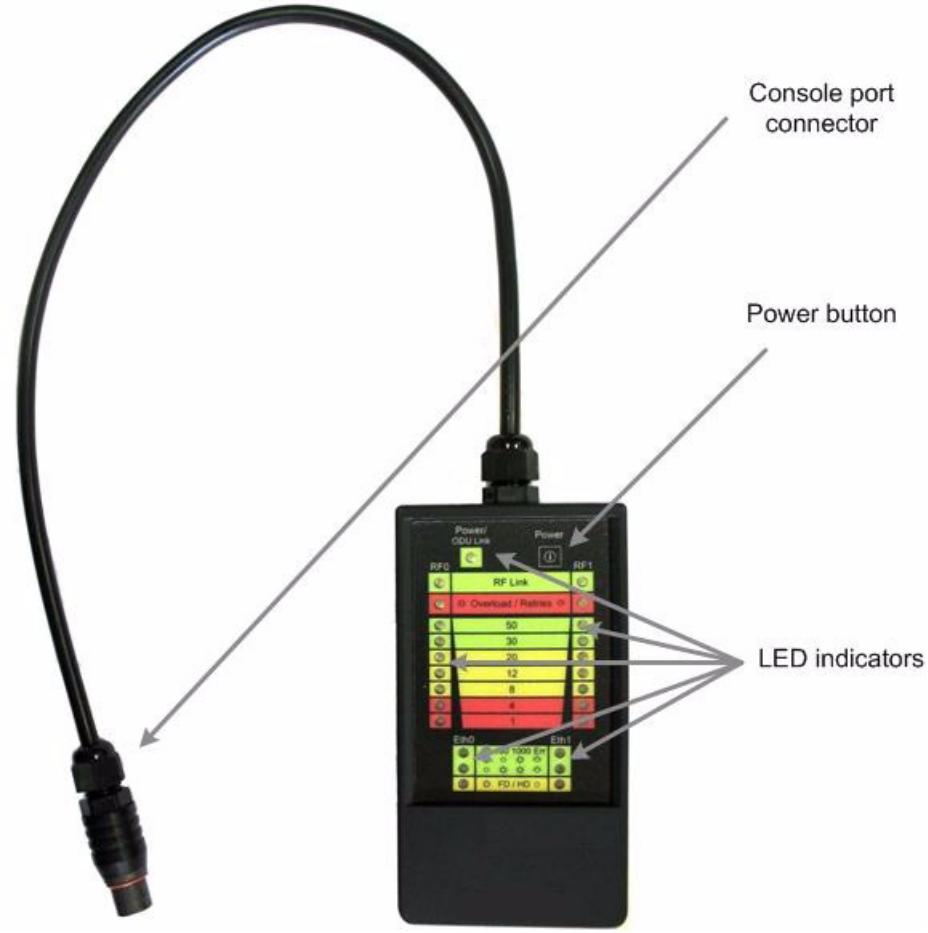


Figure 4-9: RapidView Top

Figure 4-10: RapidView Back

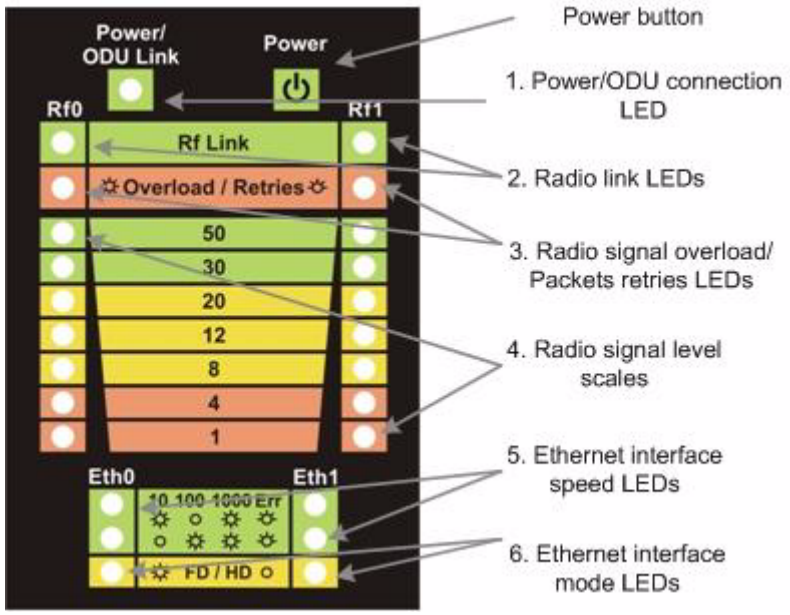


Figure 4-11: RapidView Indicator Panel

4.1.5.1 How to Use

Turning on:

1. For turning RapidView on simply push the "Power button".
2. Device LEDs will light up for 2 seconds.
3. Device will perform constant tries to connect to ODU. If device's power is normal Power/ODU connection LED (1) will blink 1 time per second. If device's power is low LED 1 will blink 4 times per second in turn with not lighting intervals.
4. Once ODU link is established, LED 1 stops blinking (if power is normal) and device's interfaces status are shown by LEDs 2-6.
5. 1 time per second device updates its status output.
6. If ODU link will be broken, LEDs 2-6 will go out after 2 seconds and LED 1 will start blinking 1 time per second.

Diagnostic device connection to ODU should be done via console port of the ODU. Once link is up between ODU and diagnostic device the following record is put in ODU system log:

```
Connected test unit. Begin service communication over console.
Test unit detected: rf0 - rf5.0
```

Exact radio interface names depend on wireless equipment configuration.

When diagnostic device is unplugged from the following record is put in ODU system log:

```
Test unit disconnected. Return to normal console mode.
```

LEDs modes description:

ODU status monitoring via diagnostic device is performed by its LEDs indication. LEDs modes and ODU status correspondence is shown in the following table:

Table 4-1: Indicator LEDs

LEDs	Function
1. Power/ODU connection LED	Shows diagnostic device power status and diagnostic device-ODU connection status. **Constant lighting** - diagnostic device-ODU connection established, diagnostic device power is normal. **Blinking 1 time per second** - diagnostic device power is normal, diagnostic device-ODU connection is not established. **Blinking 4 times per second** - diagnostic device-ODU connection established, diagnostic device power is low (change batteries). **Frequent blinking with intervals** - diagnostic device power is low, diagnostic device-ODU connection is not established.
2. Radio link LEDs	Show whether radio link is established on certain ODU's radio interface. **Constant lighting** - radio link is established. What ODU's radio interface to show by what column RF0 or RF1 is chosen by the following way: for RF0 column is taken radio interface with the least number, for RF1 the other interface. For example, there are the following radio interfaces on ODU: rf5.0. Then for RF0 column rf5.0 will be taken, for RF1 - rf5.1. When no radio link then LEDs 2-4 are not lighting.
3. Radio signal overload/Packets retries LEDs	Show receiving radio signal level overload and number of packet retries information. **Constant lighting** -receiving radio signal level on the interface is too high. **Blinking 4 times per second** - number of retries >= 50% **Blinking 2 times per second** - number of retries >= 28 % **Blinking 1 time per second** - number of retries >= 7 % If certain radio interface (radio module) is not present on the device then all corresponding LEDs of this radio interface is off. If ODU has certain radio interface but it is not activated (for example, not entered "mint rf5.0 start" command) then LED 3 is blinking 1 time per second whereas LEDs 2 and 4 are not lighting. If ODU has certain radio interface but it is not activated (for example, not entered "mint rf5.0 start" command) then LED 3 is blinking 1 time per second whereas LEDs 2 and 4 are not lighting. If ODU has certain radio interface activated ("mint rf5.0 start" command entered) then LED 3 is blinking 4 times per second whereas LEDs 2 and 4 are not lighting.

Table 4-1: Indicator LEDs

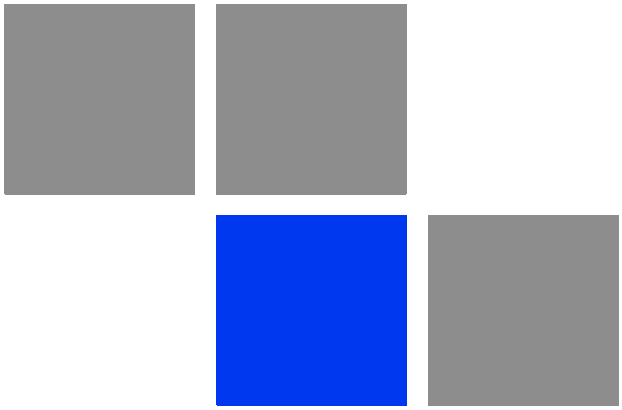
<table>
<tr><th>LEDs</th><th>Function</th></tr>
<tr><td>4. Radio signal level scales</td><td>Show receiving signal level of the established radio link.

Each LED can be in 4 modes:
Not lighting - radio signal level is lower than scale value.
Blinking - the more frequently is blinking the nearer signal level is to given scale value.
Constant lighting - signal level is higher or equal to scale value.</td></tr>
<tr><td>5. Ethernet interface speed LEDs</td><td>Show speed of corresponding Ethernet interface.

There are 2 LEDs for each Ethernet interface (Eth0 and Eth1).

<table>
<tr><td></td><td>10 Mbps</td><td>100 Mbps</td><td>1000 Mbps</td><td>Error</td></tr>
<tr><td>Upper LED</td><td>Lighting</td><td>Not lighting</td><td>Lighting</td><td>Blinking</td></tr>
<tr><td>Lower LED</td><td>Not lighting</td><td>Lighting</td><td>Lighting</td><td>Blinking</td></tr>
</table>
</td></tr>
<tr><td>6. Ethernet interface mode LEDs</td><td>Constant lighting - Full Duplex.
Not lighting - Half Duplex.

IF Ethernet connection is established but corresponding ODU's interface is not enabled then LEDs 5, 6 indicate connection configuration by blinking 1 time per second.</td></tr>
</table>



Chapter 5

Configuration Via Web Interface

In This Chapter:

5.1 Overall Functionality Overview

Web-interface is used for the following purposes:

- View and change system parameters of the device
- View and change system interface parameters of the device
- View and change radio link parameters
- View and change network parameters of the device
- Monitoring statistics for all interfaces
- Monitoring radio link statistics

5.2 Run Requirements

In order to run and properly use the application, the following requirements must be met:

- Web-browser
- OS WANFleX for MINT
- Web-interface support activated on the device (*"webcfg start" command*)

To connect to the device via Web-browser type: *http://<device IP adress> (by default http://10.10.10.1).*

5.3 Basic Settings

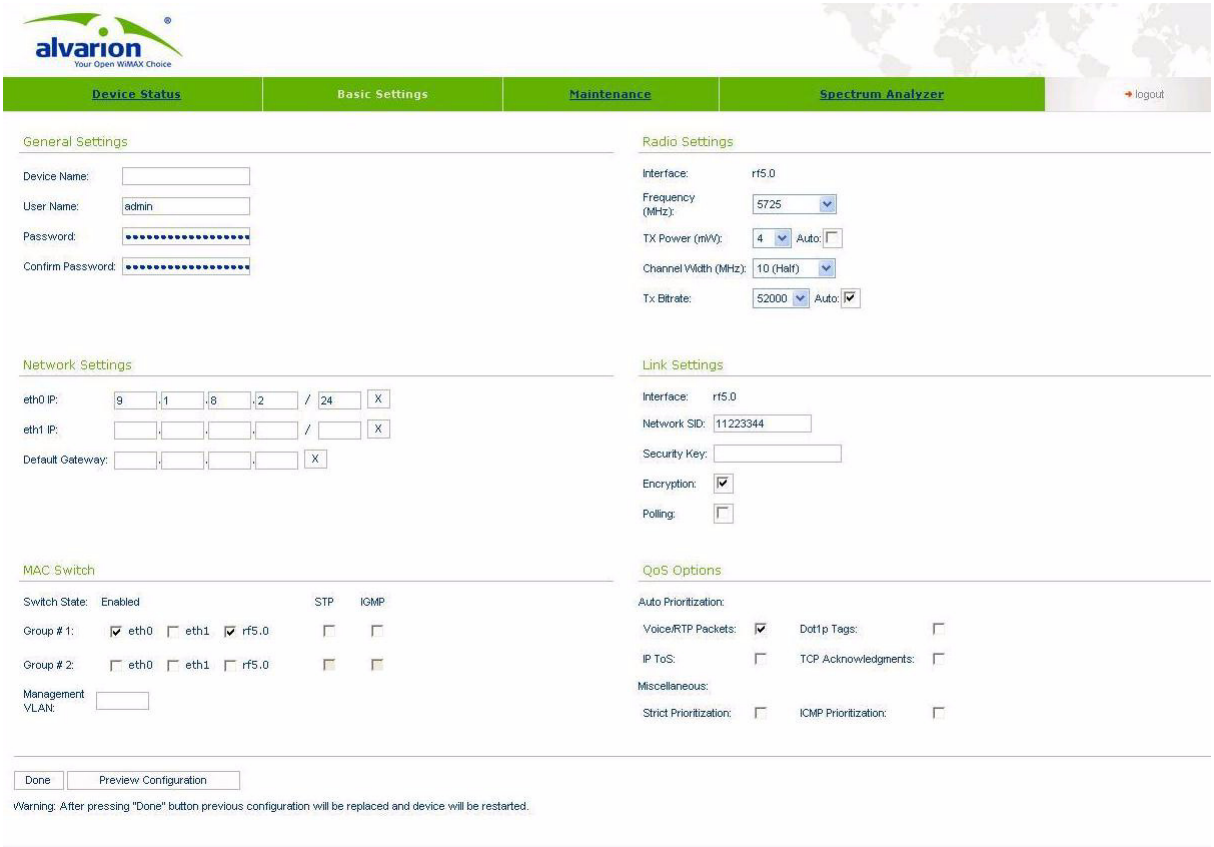


Figure 5-1: Basic Settings

The following system parameters can be changed/viewed in this sheet:

General Settings:

- Device name - general device name
- User Name - User Name used as Login
- Password - Secret Password used to login to the unit
- Confirm Password - please confirm the password to the unit

Network Settings:

- ethX IP - Primary IP-address for ethX interface

- Default Gateway - Default Gateway for the unit

Radio Settings:

- Frequency - Central Operating Frequency. Must be equal at both sides of the link
- TX Power - Output (TX) Power of the radio in milliwatts
- Channel Width - Operating Channel Width of the radio in - must be equal at both sides of the link
- Tx Bitrate - Fixed Operating Bitrate (if numerical value chosen) or Auto Bitrate (Automatic Modulation Control) if "Auto" is chosen. Auto Bitrate is recommended

Link Settings:

- Network SID - Network System Identifier (8-digit HEX figure). Must be equal at both sides
- Security Key - Key word to encode protocol messages. Must be equal at both sides
- Encryption - Enables AES encryption
- Enable Polling - Turns marker access mode on. Polling is recommended for long links (7+ km) and must be enabled just at one side (do not enable polling at both sides, otherwise wireless connection will fail!)

MAC switch:

- Group#1 - allows to create switch group and start switching on the device
- Group#2 - allows to create a second switch group
- STP -enables Spanning Tree Protocol (STP)
- IGMP - enables IGMP snooping functionality
- Management VLAN - defines VLAN for device management

To apply specified system parameters to the unit use the "Done" button.

After pressing "Done" button unit's current configuration will be overwritten with new configuration generated by Web-Interface application, unit will be restarted and turned into a switch mode.

5.4 Device Status

Figure 5-2: Device Status

"Device status" sheet allows viewing interface and radio link statistic. One can set "Auto Refresh" option to refresh the statistics automatically. Refreshment frequency can be set by "Auto Refresh Time" parameter. Device statistics can be also refreshed manually by "Refresh" button.

"Interface Statistics" section displays the following parameters of all device's interfaces:

- Interface name
- Interface MAC Address
- Status
- Mode
- Packets (Rx/Tx)
- Errors (Rx/Tx)

"Wireless Links Statistics" section displays all neighbor devices that it may physically "hear" and that satisfy the given criteria. The following radio link parameters are displayed:

- Link Quality (color indication of a connection quality: red - bad connection, yellow - "not very good" connection, green - good connection)
- Unit's interface, to which neighbor is connected
- Neighbor's name
- Neighbor's MAC address
- Distance
- Control Level (dB) Rx/Tx - signals levels for minimal available bitrate
- Current Level (dB) Rx/Tx - signals levels for current bitrate
- Bitrate Rx/Tx
- Retries (%)
- Errors
- Load (Rx/Tx) in kbps
- Load (Rx/Tx) in pps

5.5 Maintenance

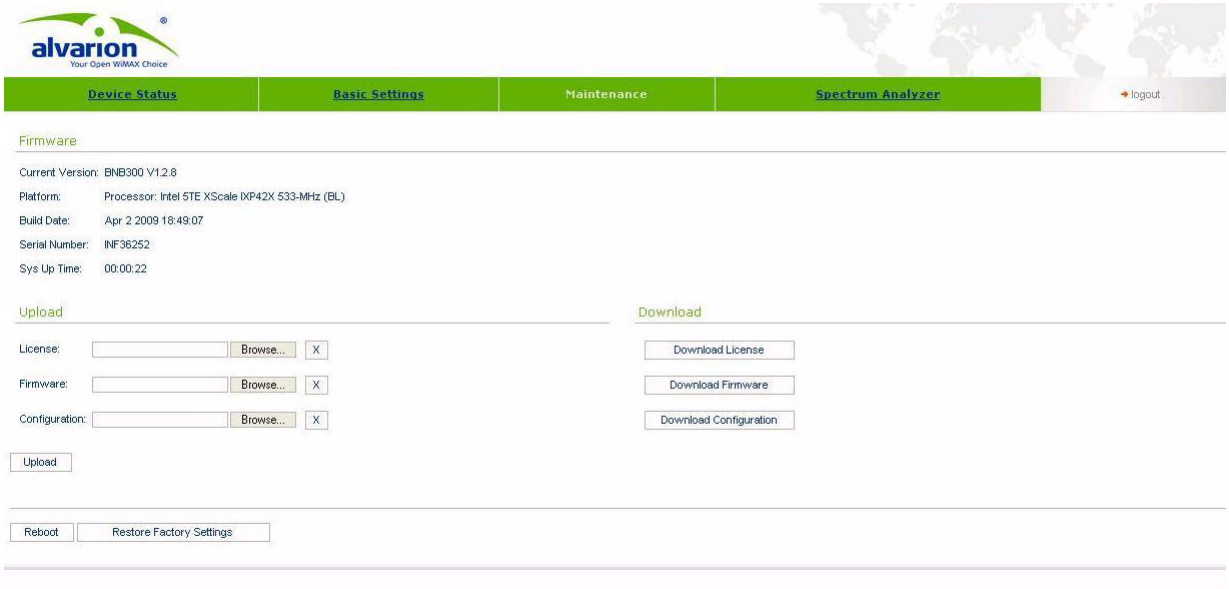


Figure 5-3: Maintenance

"Firmware" section shows current firmware version, firmware build date, serial number and system up time.

"Upload"/"Download" sections allows uploading and downloading license files, firmware and configuration on/off the device.

Pressing "Reboot" button reboots the device.

Pressing "Restore Factory Settings" button restores factory defaults configuration.

5.6 Spectrum Analyzer

Figure 5-4: Spectrum Analyzer

"Spectrum Analyzer" provides deep analysis of radio emission sources. In this mode device scans the radio spectrum on all available frequencies. To obtain information as complete as possible, the scanning process may take some time.

The following parameters can be set to manage "Spectrum Analyzer" operation:

- Unit's radio interface
- Start frequency, determining the initial frequency for scanning in MHz.
- Stop frequency, determining the ending frequency for scanning in MHz.

- Band - bandwidth in MHz.
- Step - frequency changing step in MHz.
- Channel mask - specify what antenna will scan the radio environment. "Auto" value set scanning by both antennas.

To start/stop "Spectrum Analyzer" use "Start Sensor Test"/"Stop Sensor Test" buttons.

You can get detailed information about scanned radio signals on a specific frequency. Just point a cursor on the needed frequency and you will see a hint with exact Signal level (dBm), Frequency (MHz), Noise Floor (dBm), Avg RSSI (dBm), High RSSI (dBm), Max RSSI (dBm) values.

Chapter 6

Supplementary Information

In This Chapter:

6.1 "RJ-45" Service Cable Connector Soldering Scheme

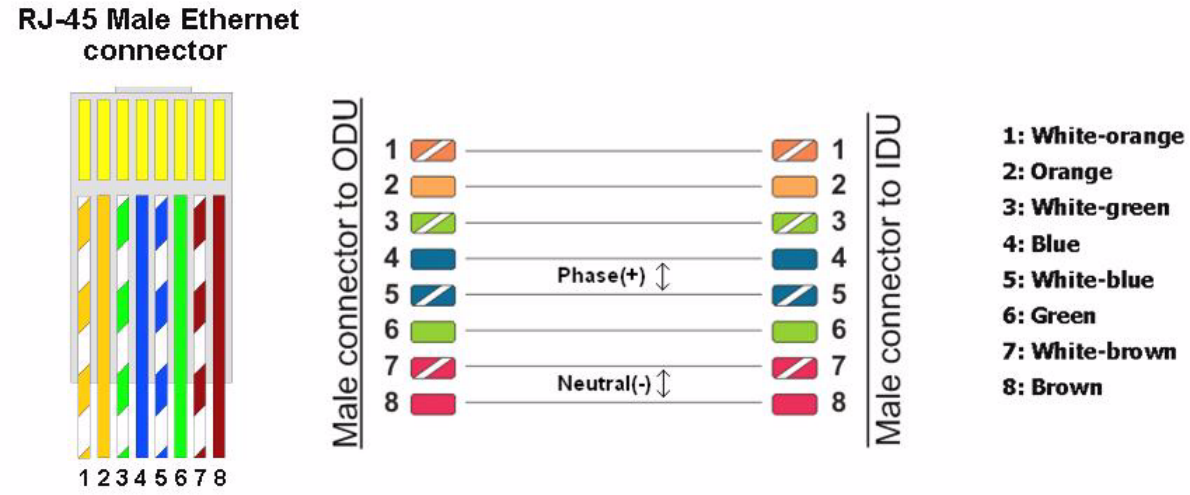


Figure 6-1: Service Cable Connector Soldering Scheme

6.2 Console Cable Connector Soldering Scheme

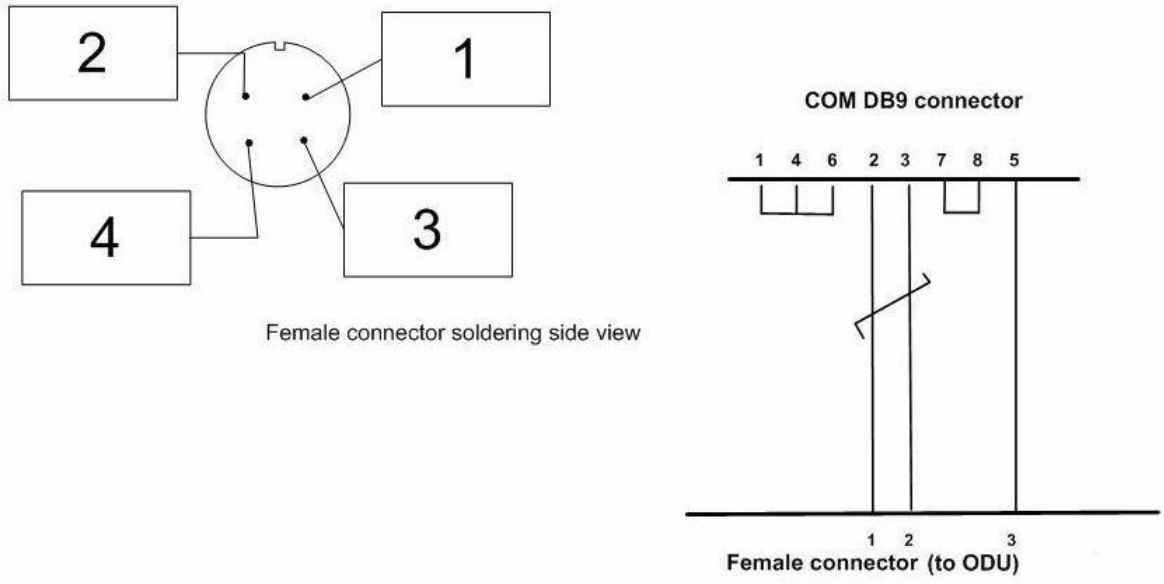


Figure 6-2: Console Cable Connector Soldering Scheme